THE NATURE OF MAN

Élie Metchnikoff

THE real nature of Man is to many folk a mystery. With quaint conceit we are apt to call this particular "island universe" of 150,000,000,000 suns *our* universe, and assume that we are the only useful objects in it. Often we do not ask necessary questions, but take for granted the everlasting existence of our consciousness, mind, or soul, considering that creatures so important as we could not perish. But what should sensible people believe of the future of Man? Is the outlook a matter for optimism or pessimism? Such are the fundamental questions faced in this book by Metchnikoff, one of the great Russian thinkers of all time. His answers, truly scientific in their outlook, will arouse keen interest, and will stimulate the thoughtful reader to further discussion of these vital issues.

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THE NATURE OF MAN

Studies in Optimistic Philosophy

BY

ÉLIE METCHNIKOFF

Professor at the Pasteur Institute

THE ENGLISH TRANSLATION

EDITED BY

SIR P. CHALMERS MITCHELL

M.A., D.Sc. Oxon.

REVISED AND BROUGHT UP TO DATE BY

C. M. BEADNELL, C.B., F.Z.S.

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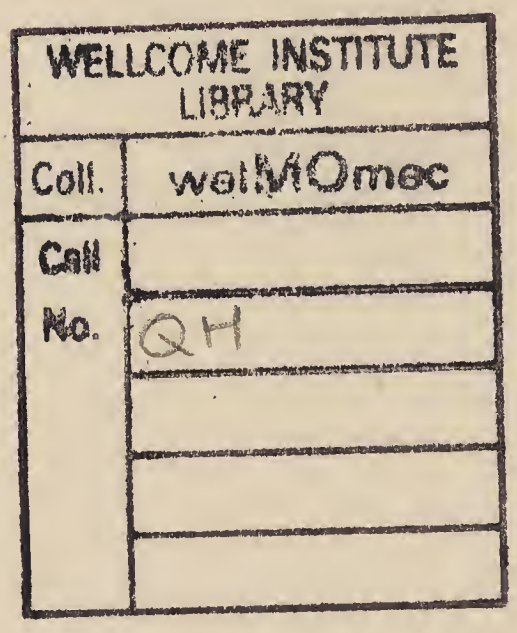

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REVISER'S INTRODUCTION

THE rising generation is apt to remark, with reference to a book by one of the intellectual giants of Victorian days: "Oh! That's by a 'has been'; what he said is quite out of date." Yet if the statement in question is a *fact*, it must be true for all time and in all places, by whomsoever uttered, whether centuries ago by a negro in Central Africa or by a Professor in London in this present year of grace. The fact that the sun appears in the east and disappears in the west is as true now as in pre-Copernican days; it is only the interpretation of the cause of the phenomenon that has changed. There is more mind-building food in many a book written fifty or a hundred years ago than in the pseudo-scientific froth so fashionable to-day. Students need entertain no qualms because this work was written at the break of the present century; its philosophy and science are as arresting and illuminating as when Metchnikoff put pen to paper.

Élie Metchnikoff, who was born on May 15, 1845, and died on July 16, 1916, was one of the greatest scientists Russia has produced. He first saw the light of day at a small village in the northern part of the Ukraine in South Russia, and received his boyhood education at the neighbouring town of Kharkov. In due course he migrated to various towns in Germany, where, under

renowned professors, he took up more specialized studies in biological science. He later returned to his native land and, as a professor at Odessa, pursued those researches in embryology, zoology, and bacteriology that have made his name world-famous. In 1882 he resigned his professorship and went to France, where he concentrated more especially on bacteriology and pathology, winning the coveted Nobel prize and eventually becoming Director of the Pasteur Institute. As a mark of their appreciation of his work, the French authorities made him an officer of the Legion of Honour.

Perhaps of all the many achievements of Metchnikoff the most important, since on it hangs the whole modern science of immunology, was his discovery of the part played within our bodies and in those of lower animals by the leucocytes or white blood-corpuscles—better termed, because of their characteristic habits, phagocytes, or devouring cells. Of these cells there are, under normal conditions, some 450,000 in every drop (60 cub. mm.) of blood. He demonstrated under the microscope the beautiful and startling movements of this wonderful body of mobile police-cells, and proved how on their activities in tracking down and slaying the enemy-microbes that have broken through our defences hangs the health, the very existence, of our bodies.

So exquisite is the sensitivity of unicellular organisms in general; so efficiently do they react to outside influences or stimuli, here approaching (positive chemotaxis) what is beneficial to them, there avoiding (negative chemotaxis) what is hurtful; so uncanny is their ability to track their prey or, as in the case of many protozoa, to

find a partner with whom to mate—so great, in a word, is their capacity to exercise *volition* and *choice* that Metchnikoff, ever loyal to the principle of continuity, conceded a mind even to these specks of living stuff. Not, of course, the type of mind exemplified in a higher animal such as man, but one as inferior and primitive in its organization as the bodily organization of the microbe is to the bodily organization of the higher animal.

Metchnikoff held that, as harmony in nature could be attained only through perfect adaptation to, and accordance with, environment, it was an ideal rather than an actuality. As this ideal state is seldom attained, it follows that disharmony in nature is, alas, the rule rather than the exception. The older school of biologists unduly harped on the harmony in nature. Like Browning, they said :—

> " God's in his heaven;
> All's right with the world."

Owing to this philosophy they were liable to overlook the many disharmonies in our world, and to think with the theologians that pain and suffering were for our good and that we should rest content with things as they are. Metchnikoff, keenly aware of the other side of the question, was determined to drag these disharmonies into the light. With Kipling he saw that :—

> " The toad beneath the harrow knows
> Exactly where each pin-point goes.
> The butterfly upon the road
> Preaches contentment to that toad."

Many years ago a writer in the *Times*, reviewing this book of Metchnikoff, put the case delightfully :—

> " The moth invincibly drawn to the flame which burns its wings, the lady-bird which loves the secret inner juice of the flowers, and every summer tries to suck the aromatic sugar of the dandelion, yet never once through all the ages has caught one drop of it—such poor wee beasties live, indeed if it be living, never to attain an unforgotten dear ideal; but ask them their opinion of the Harmony of Nature ! "

Metchnikoff showed that man, too, is not without his glaring disharmonies—such, for instance, as his reproductive system. As regards sex it may appear to some readers that Metchnikoff is rather too outspoken. But the reviser feels that in this matter he cannot do better than follow in the footsteps of the translator of the book, Sir Peter Chalmers Mitchell, F.R.S., who, in his introduction to the First Edition, said : " In several parts of this volume . . . there is much plain speaking on matters that modern civilization attempts to conceal. I have not had the impertinence to suppress or to alter a line or a word of these pages." Yet another disharmony is man's unnecessarily early death. Grit is too liable to get into the bearings of his physiological machinery and throw it out of gear, or stop its workings long before the end of the span of activity Nature intended it to have. The present average of three-score years and ten is, said Metchnikoff, far short of that which man should secure. Again, the fear of death, so characteristic of most human beings, is, he thought, really an abnormality brought about through man dying while still imbued with the potentiality for longer life. He prophesied that some day science, by means of serum

inoculations or other measures, will enable the human race to reach the age of 130 or even 140 years. When that happens the desire to die will be as natural as the desire to eat or drink. Just as the ephemerids, once the sex instinct has been satisfied, appear to welcome death, so will man, like a tired little child wishing to go to sleep, peacefully close his eyes—and depart.

There would appear to be no real reason why those particular groups of cells the premature decay and death of which cause the downfall of the body as a whole should not be capable of acquiring, as Metchnikoff suggested, a considerably enhanced lease of life. Our germ-cells, like the protozoa, are immortal—at least they are to the extent of being links in a living chain extending back to the dawn of life. Embryonic cells have been kept growing and multiplying for years in artificial cultures. Compare the cells of our brain with those of our skin. They are, so to speak, cousins, having descended from the same egg-cell. Yet while the former cease to grow and multiply when we are in our 'teens, the latter continue to do so up to the moment of death, or even, as proved by post-mortem growth of hair, for some days after death. Science is only just beginning to discover why it is that the cells of our "grey matter" are so liable to undergo "softening"—that is, to exchange their active living matter or protoplasm for inert fatty material—or why the cells of the coats of our arteries are so prone to undergo "hardening" through a similar replacement of their protoplasm by lime salts. Both "softening" and "hardening" are common accompaniments of old age and precursors of death. Recent work

by Waddington, Carrel, Spemann, and others lends countenance to the prediction of the great Russian scientist that human beings of the future will live well beyond their present age. The discovery, since Metchnikoff's day, of " organizers " that possess the remarkable power of compelling young, dormant, tissue cells to spring into activity and grow rapidly is pregnant with possibilities. These " organizers " have been found in the zygote or egg-cell, around the blastopore of amphibians, bordering the mouth of cœlenterates, and in the embryonic " primitive streak " of birds. Injected into " neutral " cells they impart to them an organizing capacity, so that these cells in their turn can exercise a growth-compelling influence over quiescent tissues. Cells that have ceased growing owing to absence of an " organizer " resume their growth and attain full development if either the natural and original, or the artificially induced, organizing material be supplied. Thus, if the egg of a newt be cut in two so that one part contains all the " organizer," the other part none, the former will grow into a perfect newt but the latter will come to a permanent halt on reaching the stage of a simple ball of cells (blastula). If, on the other hand, the egg-cell be so cut that each portion contains a bit of " organizer," the result is growth of each into a fully developed newt. If a piece of amphibian embryo has ceased to grow through lack of " organizer," and some of this from the body of *another species* of amphibian be added, the original piece will take up normal growth. Indeed, so potent is the growth-inducing character of these " organizers " that, by carefully arranged treat-

ment, Tornier succeeded in producing a worm (Planarian) with ten heads !

" Probably even the highly specialized cells in the different organs of an adult animal could remain alive almost indefinitely even although they might not be able to grow and divide. It is the animal as a whole which dies, not the individual cells of which it is made. The immortality of the cells can be realized by removing them from the body and growing them in a nutritive medium in culture. . . . Anyone who wishes to can now make certain of the immortality of part of himself as an actual material living thing by endowing a staff of experts to keep the cultures going. Each culture, of course, only contains a very small piece of tissue . . . so that it is only rather a piecemeal immortality which science offers. But at the same time each of these little cultures is growing, doubling its volume in two days, and the tip of your little finger would grow to the size of the world in less than six months."

The above quotation from C. H. Waddington, an expert research worker in tissue development, would certainly have delighted Metchnikoff.

Charles M. Beadnell.

AUTHOR'S PREFACE

In offering this book to you, reader, I feel that I must justify its publication. I admit freely that more could be said for a finished study in which hypotheses were replaced by exact facts. But to get together assured results in a field so little explored is a great task, calling for time and much labour.

I remembered the adage, "*Ars longa, vita brevis*," and I decided to publish what is really a programme of work to be carried out as fully as circumstances may permit. At all events, I hope that such a programme may have its value for younger investigators, who wish a point of orientation for their labours.

My book is addressed to disciplined minds, and in especial to biologists. As I wrote it, I had not the general public in my mind, and so I did not hesitate to devote nearly the whole of a chapter to "disharmonies in the apparatus of reproduction." I see in that apparatus the clearest proof of the essential disharmony in the organization of man.

I have to thank those friends who were familiar with my views and whose advice and assistance have helped me to develop them.

Élie Metchnikoff.

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CHAPTER I

THE NATURE OF MAN HISTORICALLY CONSIDERED

NOTWITHSTANDING the advance made by science, expressions of discontent with it are familiar. Science, it is said, no doubt has ameliorated the material conditions of human life, but is powerless to solve those moral and philosophical questions that interest cultured people so deeply. In this region science has done no more than to destroy the foundations of religion, robbing mankind of its consolations.

It cannot be disputed that a general uneasiness disturbs the world to-day. Although his environment is most favourable to the fulfilment of many of his capacities man finds himself without orientation when he has to determine the course of his life, or to explain to himself his true relation to such categories of humanity as family, nation, and race. This uneasiness reveals itself as discontent, and it leads to pessimism or to mysticism.

A remedy for this malady of the age has been sought in the attempt to restore religious and mystical faith. On all sides have sprung up efforts to found new religions or to amend the old. It is no new thing to ask if there be nothing but faith to control human conduct and to lead mankind towards universal happiness.

In the ancient world, and, above all, among the Greeks, human nature was held in high esteem. The Oriental races, predecessors of the Greeks in civilization, generally represented their gods as fantastic or grotesque beings, composites of men and animals. The Greeks

made gods in their own image, giving them all the most beautiful qualities of the human race.

This adoration of human nature appeared in Greek plastic art and was the cause of its excellence. The ideal of art was to copy, in the most faithful way, the most perfect example of the human body, and Greek artists made measurements of the body so accurately that modern science has confirmed their chief results.

Just as Greek art aimed at the presentation of the body of man, so Greek philosophy proclaimed the nobility of all human qualities, and inculcated the doctrine of a harmonious development of all sides of human nature. According to Xenocrates (fourth century), happiness consisted not only in the possession of human virtue but in the accomplishment of all natural acts.

The principle of a worship of human nature is in itself rather vague, and it is not surprising that disputes and contradictions arose in relation to its application. Thus Plato excluded pleasure from his conception of the good, while Aristotle, Plato's pupil, held a contrary opinion. For Aristotle, pleasure was the natural motive of human action, and its attainment was associated as intimately with the perfect life as beauty and health were associated with the perfect human body.

For the Stoics, the *summum bonum*, happiness, and the most lofty aim could not be found except by conforming life to nature. Conduct was to be brought into harmony with the rational order of nature in such a fashion that no rational being would perform actions not deducible from the general law. The same principle of a life in harmony with nature led the Epicureans to the conclusion that " pleasure is a natural good—that is to say, a condition conformable with nature, and so bringing with it intrinsic contentment."

The Roman philosophers adopted the principle of a life strictly natural. Seneca, for instance, enunciated the maxim : " Take nature as your guide, for so reason bids you and advises you; to live happily is to live naturally."

The Greek conception of a life in harmony with nature found its most complete development in the Rationalism of the Renaissance and of the centuries that followed it. The French philosophers of the eighteenth century, who sought to replace the religious foundations of conduct by rational principles, again had recourse to human nature. Holbach, a materialist and atheist, laid it down as an axiom that " to be universal, the moral law must be founded on the essential nature of man—that is to say, on the properties and qualities found constantly in the human being, and that distinguish him from other animals."

The principle of ancient philosophy reappeared in the works of Rationalists of the nineteenth century. Wilhelm von Humboldt declared that " the ultimate ideal of man, the ideal prescribed for him by the irrefutable and eternal laws of reason, consisted in a development as harmonious as possible of all his qualities in their entirety." The historian, Lecky,[1] defines the aim of life as the full development of all that exists in the proportions determined by nature.

Philosophers and historians are not alone in the adoption of Greek Rationalism; many naturalists have spoken in the same sense. Darwin wrote : " The term general good may be defined as the means by which the greatest possible number of individuals can be reared in full vigour and health, with all their faculties perfect, under the conditions to which they are exposed." [2]

[1] *History of European Morals.*
[2] *The Descent of Man.*

Herbert Spencer,[1] in analysing the aim of existence, came to the conclusion that morality should be adjusted so as to make life as full and complete as possible. As a criterion of physical perfection, the English philosopher would accept only the complete devotion of all the organs to the accomplishment of all their functions, while his criterion of moral perfection was contribution to the general good. These views express the Greek ideal.

While, then, rational philosophers in all ages have sought the foundation of morality in human nature itself, and have held human nature to be good, or even perfect, many religious doctrines have displayed a very different view. Human nature was regarded as being composed of two hostile elements, a body and a soul. The soul alone was honoured, while the body was regarded as the vile source of evils. Such a view led to the flagellations and torturings of the body that form so strange and so widespread a phenomenon. The Hindu fakirs who swing themselves on hooks, the dervishes and Mussulman Assouans who beat in their skulls with clubs, the Russian Skoptsy who emasculate themselves, all make it plain that natural perfection is not taken as the guide to conduct.

Buddha showed his belief that human nature was base. Coming out from the apartments of the women, there came to him a " vivid idea of the impurity of the body, a feeling of repulsion from it, and of blame of it; regarding his own body and seeing its wretchedness, he began to despise it, and to formulate conceptions of impurity and purity; *from the sole of the feet to the crown of the head, to the limit of the brain, he saw that the body was born in impurity, came from impurity, and always let itself be drawn to impurity.*" These reflections led him

[1] *The Data of Ethics.*

to the conclusion : " What wise man, having regarded his own body, will not see in it an enemy ? "

Towards the end of the old world, the Greek theory of human nature yielded to a very different conception. The opposition between the opinions of the Stoics on morality, and their admiration of human nature, led Seneca, one of the last Roman Stoics and a celebrated contemporary of Christ, to break completely away from the ancient doctrine. Convinced of the moral weakness and imperfection of man, and of the persisting power of evil, Seneca declared that human nature contained a vicious and essentially evil element. This element was seated in the body, which he regarded as so essentially vile that it is to be despised. Our body was no more than the dwelling of the soul, its temporary home, a place in which it cannot be at rest. The body was a burden that the soul would be rid of, a prison-house whence it would escape.

A dualism still more pronounced was characteristic of the early Christian view of human nature, and led to the depreciation of the body as compared with the soul. In the fourth and fifth centuries such a view was so dominant that a struggle against the material side of our nature became a rule of life. The most absolute asceticism spread throughout the Christian world.[1] A struggle against hunger, thirst, and desire for sleep, rejection of all pleasures that come from impressions of sight, of hearing, or of the palate, and above all abstention from sexual intercourse, became, in the opinion of believers, the true aim of human life. The conviction that human nature was essentially corrupt led to a declaration of war against it ; all pleasures were forbidden, even the most innocent of them being thought vicious. What could be more in contrast with the calm and joyous philosophy of the

[1] Lecky, *History of European Morals.*

Greeks, for whom there did not exist the idea of a struggle against the supposed corruption and imperfection of man? The dualistic theory made such demands on its proselytes that these, absorbed in the salvation of their souls, sank from the physical point of view to the level of wild beasts. Hermits resorted to the lairs of animals, abandoned their clothing and went about naked with shaggy and disordered hair. In Mesopotamia and a part of Syria there arose a sect who had no dwellings and who ate neither bread nor vegetables, but wandered on the hills and fed on the herbage. Cleanliness of the body was regarded as an indication of corruptness of the soul, and among the most highly venerated of the saints were those who took no care of the body. Athanasius relates with approval that when St. Antony, the father of monks, became old he never washed his feet.[1]

Such doctrines soon brought about a most serious perversion of the innate instincts of the human race. The senses of family and of society became so weakened that fanatical Christians were more than indifferent to their kinsmen and countrymen. It is told of the Abbot Sisoes that, on a believer asking to be received into the convent, he inquired if the suppliant had any one akin to him. "I have only a son," said the Christian. "Well, then," said the abbot, "take your son and cast him into the river, for thus only may you become a monk." The father set about to do the bidding of the abbot, and it was only at the last moment that the order was recalled. For admission into a Christian community it was necessary to renounce one's country.[1]

In the opinion of the ministers of the Scotch Church of the seventeenth century, according to Buckle,[2] there was nothing in the created universe so monstrous and so horrible as man.

[1] Lecky, *loc. cit.* [2] Buckle, *History of Civilization in England.*

It was to be expected that when such conceptions prevailed celibacy and repudiation of the reproductive instinct should have been made obligatory on the clergy. The words in St. Matthew (xix. 11, 12): "There be eunuchs who have made themselves eunuchs for the kingdom of heaven's sake" were interpreted by some as implying a voluntary renunciation of marriage, while others insisted on the literal meaning and in consequence mutilated themselves more or less completely. The breasts of women were removed to eradicate the maternal instincts. The wish announced by St. Paul (Corinthians vii. 7): "I say therefore to the unmarried and widows, it is good for them if they abide even as I; but if they cannot contain, let them marry, for it is better to marry than to burn," soon became a command, and since the fourth century the Catholic Church has advocated celibacy of the clergy, although it was not enforced until the eleventh century (under Gregory VII.). A low view of human nature has survived in the Catholic Church even to our own times.

Art has reflected the Christian conception of human nature. Sculpture, which played so great a part in the ancient world and which was intimately associated with Greek ideals, began to decline rapidly in the Christian era. It lasted longer in the Roman Empire of the East, but in Italy it was almost completely forgotten by the eighth century. Painting survived, but not without undergoing an extraordinary degeneration. All the Italian works of art of the Carlovingian period displayed the utmost indifference to natural form, and a loss of the sense of harmony and beauty.

The intimate connection between the depreciation of human nature due to Christian doctrine and the inferiority of the art of the Middle Ages cannot be denied. Taine writes of the period as follows: "If one consider

the stained-glass windows or the images in the cathedrals, or the rude paintings, it appears as if the human race had become degenerate and its blood had been impoverished; pale saints, distorted martyrs, virgins with flat chests, feet too long, and bony hands, hermits withered and unsubstantial, Christs that look like crushed and bleeding earthworms, processions of figures that are wan, and stiffened, and sad, upon whom are stamped all the deformities of misery and all the shrinking timidity of the oppressed."

The art of the Middle Ages fell lower and lower until the Renaissance, with its return to the Greek ideal, brought new vigour. The great masters of the Renaissance were also scientific men who had studied mathematics and who employed the technique of mensuration; such were Alberti, Leonardo da Vinci, Michel Angelo, and others. The return to the Greek ideals and to nature brought with it the taste for beauty.

When the ancient spirit was born again, its influence reached science and even religion, and the Reformation was a defence of human nature. The Lutheran doctrines resumed the principle of a " development as complete as possible, of all the natural powers " of man, and saw in that ideal a guide for humanity. Compulsory celibacy was abolished, and free play was given to all the tendencies in conformity with the laws of nature.

Besides those whose religion led them to despise the human body, there have been many savage races and tribes who have practised mutilations of the body. Treatises on Ethnography and the volumes of travellers contain a multitude of details of this sort. The hair, the teeth, and the lips have been subjected to treatment with the object of making them as unlike the natural condition as is possible. Many of the lower races discolour their teeth, or remove some of them, or file them to points.

Others insert in the lips pieces of wood, of stone, or of bone. The skull, the breasts, and the feet have all been subjected to deforming treatment.

Although there is not enough evidence to set down these practices to the existence of definite and self-conscious religious or philosophic doctrine, it is at least certain that the people among whom they occur, far from revering human nature in the fashion of the Greeks, distort it. Discontent with natural conditions is so widespread that there is good reason for an inquiry as to the existence of some general principle underlying this diversity of opinion regarding human nature. I have already shown that this problem of human nature has for long interested mankind, and has taken a large place in the formation of ideas of the good and the beautiful. I shall try to give an exposition of human nature in its strength and in its weakness. But before passing to man I shall survey the lower forms of life, hoping to fix some landmarks that will be useful in the study of the larger problem.

CHAPTER II

HARMONIES AND DISHARMONIES AMONG BEINGS INFERIOR TO MAN

Long before man appeared on the earth animals and plants were distributed over it. Some of these were endowed with but vague senses, while others had well-developed instincts, and some even a certain degree of intelligence which they applied for their self-preservation and for the propagation of their kind.

Many species, well adapted for resistance to external influences, have survived from very early times to the present day. In the Carboniferous period birds and mammals did not yet exist, and the thick forests with undergrowths of gigantic ferns were inhabited by large numbers of articulated animals, among which were scorpions and insects. The scorpions of that time resemble in every way those that live at the present day in tropical countries; and among the insects of that early epoch were some very like the cockroaches of to-day. Certain tree-like ferns of the present time are very similar to those of the coal period. Among the animals the bodies of which are protected by a shell, such as foraminifera and mollusca, certain species have survived even from an earlier time than the coal period.

In contrast with these extraordinary survivals, there are instances of the complete disappearance of numbers of species of animals and plants. During the Tertiary epoch, the virgin forests of Europe were inhabited by a large number of monkeys and by some anthropoid apes (*Dryopithecus*) of which fossil remains are now found.

These animals, notwithstanding that their organization was superior to that of scorpions and cockroaches, have not been able to adapt themselves to the altered conditions of modern Europe. A similar fate has come upon some of the higher mammals, such as the mammoth and the mastodon.[1]

These facts do not support the prevalent idea that there exists in nature a law of universal progress tending to the production of organisms more and more perfect from the point of view of complexity of structure. It is incontestable that forms higher in the scale of life have developed only after the appearance of lower forms. But it does not follow that development always takes a progressive march. Man is one of the later species that have appeared upon the earth, but there are others of still more recent date. It is very probable that certain species of lice have appeared subsequent to man, particularly the clothes-louse (*Pediculus vestimenti*). Among the true parasites which live only in the human body are some that have acquired their specific characters *after* the appearance of man. Such are certain tapeworms, and the microbes of human diseases.

In nature, then, there is no blind tendency towards progress. Numerous organisms are born every day with variable characters. Those among them which are adapted to existing circumstances survive and produce offspring like themselves, but many do not reach maturity and die without leaving issue.

Among organisms that attract our attention by their pleasing aspect, there are not many that can rival flowering plants. There can be no doubt that these have not been developed to satisfy the æsthetic tastes of man, for the simple reason that they existed for a long time before man's appearance.

[1] See Appendix I.

Every one admires the great beauty of orchids. There is one which, for three-fourths of a century, has been cultivated by man in many tropical countries. This is the vanilla, the fruit of which produces one of the sweetest of spices. In former days the pods of only the wild vanilla of the forests of Mexico and South America were gathered. But the use of vanilla for flavouring has rendered its artificial culture lucrative; consequently the plant was transported to several countries where it could be acclimatized. It flourished and bore numerous blossoms, but it never produced the fruit from which alone the aroma is obtained. As this sterility entailed great loss, the matter was investigated, and it was found that the flower remained sterile because the female and male parts could not come in contact. The pistils and stamens of the flower were well developed, but between these sexual organs was a membrane which prevented fertilization. A young black slave, Edmond Albius, a native of Réunion, discovered in 1841 a practical method by which the male and female germ-cells of the vanilla could come together. At the right season he introduced a small bamboo point into the vanilla flowers, thus fertilizing them so that they bore fertile pods.[1]

In the original home of the vanilla the intervention of man is unnecessary. In Guiana and Mexico fertilization of the flower is the work of small bees (*Melipona*). They visit the vanilla flowers to extract nectar, the material of their honey. Small humming-birds also hover over the vanilla blossoms, and by introducing their bills into the sexual organs of the flowers bring about contact of the male and female elements.

But it is not only the vanilla that requires the co-operation of living beings to produce its fruits. It is

[1] See Appendix II.

the case with many other orchids. In the flowers of these the pollen is massed together and cannot be transported by the air. It needs the aid of insects, as had been pointed out by Sprengel in the eighteenth century and later by Darwin.[1]

Insects, such as certain bees, wasps, flies, beetles, butterflies, and moths, visit orchids to sip the nectar stored in the flowers. In order that the proboscis may reach the sweet juice, the insects must touch first the upper parts of the flowers, where the anthers are present. The pollen grains are clustered in masses, known as pollinia, and these adhere to the body of the visiting insect by means of an adhesive fluid which is secreted by an organ of the flower known as the *rostellum*. In this way the pollinia adhere firmly, it may be to the proboscis of butterflies, or to the head or other part of the body of insects. They can leave the flower and fly off without losing the adhering pollinia, and in this manner they serve as the agents for the fertilization of the orchids.

When an insect, bearing these pollinia, enters another flower of the same species of orchid, it inevitably comes in contact with the female apparatus, more particularly with the viscous surface of the stigma. Some of the grains of pollen contained in the pollen-mass adhere to the stigma and thus fertilize the ovule. This carriage of pollen from one flower to another is necessary for the production of good seed; seed resulting from self-fertilization is inferior.

The structure of the flowers of orchids shows that they are adapted in a truly marvellous way to the visits of insects that convey pollen. In each part of these flowers one can discern some useful arrangement to secure cross-fertilization.

For the proper transmission of pollen it is necessary

[1] Darwin, *The Fertilization of Orchids*.

that the pollinia should adhere very firmly to the body of the insects, and that the viscous substance which holds them together should have time to solidify. It is thus of great advantage to the plant if the insects remain for a considerable time on the flower. In several orchids the nectar is not easily accessible, and frequently the insect has to search before finding what it desires, and sometimes it even has to pierce a membrane before reaching the fluid. These things take time, and this is long enough to allow the mucus by which the pollinia adhere to the insect to set firmly.

Those orchids, the mucus of which sets instantaneously, have nectar easy to extract, and the insect finds it without loss of time.

Darwin, in describing these facts, says :—

" In these five species (in which the viscid matter is so adhesive that it serves to attach the pollinia firmly to the insects without getting hard), and in these alone, we find copious nectar ready stored for rapid suction in open nectaries. On the other hand, whenever the viscid matter gets hard by exposure for a short time to the air, it would manifestly be advantageous to the plant if insects were delayed in obtaining the nectar; and in all such species the nectar is lodged within intercellular spaces, so that it can be obtained only by the inner membrane being penetrated at several points, and this will require time. If this double relation is accidental, it is a fortunate accident for the plants; but I cannot believe it to be so, and it appears to me one of the most wonderful cases of adaptation which has ever been recorded."

Some orchids secrete instead of nectar a clear liquid like water. This fluid is collected in a petal inserted at the lower part of the flower and shaped into a deep, cup-shaped receptacle. It does not attract insects, but by wetting their wings compels them to leave the flower by a different exit which passes close to the reproductive organs (*i.e.*, the anther and the stigma). The soft linings of the cup are greedily devoured by bees which fall into the cup, whereupon their wings become so wet

as to prevent their flying away, and they are obliged to get out by the channel that carries off the waste from the receptacle. As the saturated bees creep along the narrow passage after their involuntary immersion, they come inevitably in contact with the stigma and the masses of pollen. The latter adhere to the bodies of the bees and can be conveyed to the sticky stigma of a neighbouring flower.

In other orchids the male elements are discharged by a spring-like arrangement on to the body of insects. When certain parts of the flowers are touched, the pollinia are thrown off like arrows which, in place of barbs, have viscid swellings.

"The insect, disturbed by so sharp a blow, or after having eaten its fill, flies sooner or later away to a female plant and, while standing in the same position as before, the pollen-bearing end of the arrow is inserted into the stigmatic cavity, and a mass of pollen is left on its viscid surface. . . . Who would have been bold enough to have surmised that the propagation of a species depended on so complex, so apparently artificial, and yet so admirable an arrangement?" [1]

One orchid (*Herminium monorchis*), which bears very small flowers, is fertilized by very small insects. These minute insects can enter the flower only in a particular way, and at one of the corners. This causes the pollinia to become attached always to the same place, which is on the outer side of one of the two front legs. When the carrier of the pollinia enters a second flower, it can scarcely fail to fertilize the stigma, which is on the corresponding side. Darwin said that it would be difficult to find another case in which there was so marvellously complete an adaptation.

In addition to orchids, there are other flowers the organization of which is adapted in a remarkable way to fertilization by insects. But to find perfect harmony in the nature of living beings it is not necessary to confine

[1] Darwin, *loc. cit.*

our observations to flowers. The animal world furnishes us with numerous examples.

Every one has seen, flying near the ground, small, slender, and pretty wasps. From time to time these bury themselves in the earth or sand, and reappear in a few minutes. These are the fossorial wasps, the interesting habits of which have been studied by M. Fabre. They lead solitary lives and differ in their habits from their congeners. Bees feed their larvæ with honey and pollen during the whole period of their development. Wasps are carnivorous, predatory insects, and bring their spoils to their soft and feeble larvæ which are unable to provide for themselves. Bees and most wasps look after the welfare of their young ones in the fashion of human parents in nurseries.

FIG. 1.—CERCERIS (after Buffon). [The line shows natural size.]

Fossorial wasps, however, lay their eggs in burrows, sunk in the soil and hermetically sealed. The larvæ are hatched underground and are never seen by the mother, provision sufficient for their development having been made in advance. Before depositing eggs, the females dig the burrows and fill them with the spoils of the chase, which consist sometimes of spiders and sometimes of crickets or other insects. Each species of fossorial wasps preys on a particular kind of victim for the purpose of provisioning the burrows. Léon Dufour, the entomologist, was much struck by the ability displayed by certain wasps (*Cerceris*, Fig. 1) in seeking out and capturing the *Buprestis* beetles which he had great difficulty in finding himself. In making a study of these

beetles he collected the material from the burrows of *Cerceris*, and so avoided the laborious task of obtaining them in the natural state of freedom. The burrows were filled with motionless, but perfectly well preserved, beetles. Although dead beetles dried up in a short time, those recovered from the burrows remained in a good state of preservation for weeks. Dufour came to the conclusion that the wasps kill their prey, but inject into them some antiseptic liquid which preserves their flesh.

M. Fabre pursued the study of the habits of fossorial wasps further. He ascertained that the captured insects were not dead, but only paralysed. The continuance of the function of certain organs demonstrated that the *Buprestes*, weevils, and other small creatures collected in the burrows of fossorial wasps were alive. They could even perform some slight movements, but they were incapable of locomotion and so could not escape. The mechanism of this paralysis is one of the most remarkable phenomena in nature. The fossorial wasps, guided by instinct, having seized an insect or spider, bury their sting in the nervous centre which controls the movements of the legs. When animals with soft bodies, such as spiders and young crickets, are attacked, the operation does not present any difficulties. But beetles in general, and *Buprestes* and weevils in particular, are furnished with a hard covering which cannot be perforated by the small and slender sting of a fossorial wasp. To gain their object the wasps probe exactly between the first and second pair of legs in the median line of the under surface of the thorax, where the skin is thinner, and so introduce their sting into the ganglia from which arise the nerves of the legs. In the case of *Buprestes* these ganglia are set close to one another, and a single prick suffices to affect the nervous centres of three pairs of legs. Once the sting has been inserted in

this way the beetle becomes paralysed, but lives for many days. The *Cerceris* which preys on *Buprestis* "appears to have made its choice according to the dictates of an exact physiology and anatomy. It is impossible to see in its proceedings the results of happy chance; more than chance is required to explain adaptations so precise." [1]

After having filled the burrow with a sufficient quantity of insects or spiders, fossorial wasps lay their eggs and carefully close up the entrance. In due course the larva is hatched, and devours the food that it finds close at hand. If the gathered insects were not paralysed they could easily escape from their prison; if they were dead, putrefaction or desiccation would render them unfit for the larvæ. It is therefore sheer necessity that is the factor in the development of this marvellous instinct that induces the fossorial wasps to attack the nervous centres of their prey. When one insect has been devoured, the larva proceeds to another, and so on, until it is fully grown, whereupon it envelops itself in a case that protects it during the winter and following spring. In summer it changes at first into a chrysalis, and later into a perfect insect which takes to flight and enters upon a life like that of its mother, which it has never seen.

Any close investigation of organization and life reveals that, besides many most perfect harmonies, there are facts which prove the existence of incomplete harmony or even absolute disharmony. The examination of the flowers of orchids would lead one to the belief that each part, even the smallest and apparently most insignificant, has its rôle in the mechanism for fertilization and cross-fertilization. In reality it is not so. There are in certain orchids organs which do not fulfil any function.

[1] Fabre.

Even among the species of *Catasetum*, in which the pollinia are thrown with force on to the bodies of insects, there are some female flowers in which the male organs are rudimentary and without utility. In these flowers, according to Darwin, "the two membranous sacs containing the rudimentary pollen-masses never open, but they easily separate from each other and from the anther. The tissue of which they are formed is thick and pulpy. Like most rudimentary parts, the pollen-masses vary much in size and form; they are only about one-tenth of the bulk of those of the male."

The existence of these rudimentary pollinia, incapable of being transported or of fertilizing the female element, is easily explained by the supposition that formerly the flowers of the *Catasetum* were true hermaphrodites, but that in the course of time the male organs have become incompletely atrophied in certain flowers, in which, on the other hand, the female organs have increased. The occurrence of actual degeneration is shown by the existence of rudiments of the pollinia too insignificant to accomplish their normal functions.

Rudimentary and useless organs are widely distributed; familiar instances are the atrophied eyes of animals that live in the dark, and the rudimentary sexual organs of many plants and animals.

Not only are orchids and other flowers adapted to fertilization by means of insects, but many insects display special adaptations for visiting flowers. Butterflies, bees, and other insects possess mouth organs modified for the purpose of penetrating flowers to secure nectar or pollen. Other insects, again, are not so fortunate in this respect. Darwin on one occasion "found an extremely minute hymenopterous insect vainly struggling to escape, with its head cemented by the hardened viscid matter to the crest of the rostellum and to the

tips of the pollinia of an orchid. The insect was not so large as one of the pollinia, and after causing the explosion had not strength enough to remove them; it was punished for attempting a work beyond its strength, and perished miserably."

Many insects, well adapted for the purpose, delight in sucking the nectar of flowers. Others would wish to do the same, but their want of adaptation baffles them. A small "lady-bird" loves the sweet juice of flowers; it tries often to suck the nectar of the dandelion, but without success. Hermann Müller has described the behaviour of this insect in procuring the nectar of *Erodium cicutorium*.

"The awkward way in which this beetle, unadapted to feed on the plants, endeavours to obtain the honey, is too ludicrous not to be mentioned. After taking up a position on the petal, it puts its mouth in the direction of one of the honey-cups which are situated on both sides of the base of the petal. The petal soon breaks off, upon which the insect fixes itself on a neighbouring sepal or falls to the ground with the petal. In the first case it proceeds to creep over the flower and ends by detaching all the petals; in the other case, on recovering from the shock, it quickly ascends another stem of the same plant and begins again. I have seen the same lady-bird fall four times in succession with petals which it had detached without gaining wisdom."

The instincts of insects, well developed for certain functions, often present aberrations more or less whimsical and remarkable. The caterpillars of some butterflies, before changing into chrysalises, envelop themselves in well-woven cocoons capable of protecting them from noxious influences. Protected by this covering, the caterpillar changes into a chrysalis, and later into a butterfly which perforates the end of the cocoon in order to emerge. When any external agency destroys the cocoon, normal metamorphosis becomes impossible, and the larva dies before its maturity. Fabre questioned whether the caterpillar during the time of the weaving of the cocoon were capable of repairing it if it were

damaged. To decide this he cut with a pair of scissors the end of a cocoon in the course of construction by the caterpillar of the beautiful peacock-butterfly. In spite of the hole thus produced, the caterpillar continued its ordinary work without suspicion that it would be of no avail. On this occasion "the caterpillar of the peacock-butterfly, notwithstanding the certain fate of the future butterfly, continued peaceably to spin, without in the least modifying the regular course of its labour; when the time had arrived for the putting in of the last defensive stitches it closed the cocoon carefully, but neglected to mend the destroyed part of the barricade. It finished its vain task, ignoring what was indispensable for success."

FIG. 2.—PELOPÆUS (after Buffon).

Even among fossorial wasps, the instincts of which are so admirably developed, harmony is far from perfect. Fabre endeavoured to ascertain what effect was produced on these insects by taking away the egg laid in the burrow. He chose for this experiment the fossorial wasp *Pelopæus* (Fig. 2), which preys on spiders. He took away the egg which had been deposited in a carefully-prepared burrow, and watched the subsequent manœuvres. "The *Pelopæus* continued to store up spiders for the stolen egg; it gathered provisions that were not to be eaten; it redoubled its efforts to replenish a larder that I was constantly robbing with my forceps." The insect neither discontinued its fruitless task nor appeared to be aware of its fruitlessness. Here, then, is

an example of a foiled maternal instinct that gained no useful end.

In connection with such a slaughter for the benefit of a progeny that will never exist, I may mention observations relating to a quite different order of phenomena. Not infrequently rabbits kill and devour all their progeny, or leave them to die without food or care. Sometimes the culprits are young rabbits without experience; but this aberration of instinct is also met with in old rabbits, which once and for all have contracted the habit of abandoning or eating their young. Some females of other species of mammals and of birds often desert or kill their offspring.

Perversion of sexual instinct is frequent enough among animals. When male ants have a lack of females they ravish the workers, the attacks being fatal, as the sexual organs are incompletely developed and functionally incapable. Abnormal pairing has also been observed in a stag-beetle of the genus *Lucanus*, in bees, and, above all, in cockchafers. Higher animals, such as dogs, furnish analogous examples of sexual perversion. Onanism is well known among mammals. It is frequent among monkeys in menageries, and also in rutting stags, the latter discharging the seminal fluid by friction with trees. Stallions and mares have often been observed in the act of satisfying their sexual appetites by abnormal means. Dogs, bears, chamois, elephants, parrakeets, etc. resort to onanism.

Who has not seen in the summer numerous insects gathered round lamps and candles, attracted by the light? Among these are beetles, Caddis flies, may-flies, and, most frequently of all, small nocturnal moths. After flying round and round the light several times, they singe their wings and die in numbers. This instinct is so constant and so developed among many

of these insects that it has been used against them for their own destruction. Thus, among the means advocated for destroying a certain moth, the caterpillars of which devour cereals and beetroot, is the lighting of numerous fires in the fields. The moths, attracted by the light, fall in the flames and die in quantities.

When the usual swarms of may-flies emerge from the water, fishermen make straw fires on their boats, and the insects singe their wings. The bodies incapable of flight fall into the water, and provide a coveted food for the fish. This disharmonious and fatal instinct is displayed chiefly by nocturnal insects that rest during the day and do not leave their retreats till after sunset. In cornfields, beetles of the genera *Anisoplia* and *Rhizotrogus*, resembling each other in form and general appearance, are to be found. When a fire is lighted at night it is only the *Rhizotrogus* that approaches it at the risk of its life; the *Anisoplia* remains in the corn. The latter beetle pairs during the day, while the *Rhizotrogi* do so during the night. Moreover, it is the males only of this species that fly about in the dark and approach the fire, while the females rest on the plants. It is probable, therefore, that light induces a sort of sexual excitement in these male beetles, who, searching for the females, believe them to be in the midst of the flames, towards which they fly without being conscious of the danger they incur.

Of the may-flies attracted by fire in such great quantities, males are by far the more numerous. It is therefore really very probable that the mad excitement which leads to the destruction of so many male insects represents a sort of sexual aberration. In this connection it is to be remembered that, among beetles, species exist of which the females, hidden in the grass, produce light which attracts the males. In the common glow-worm,

the female, which is wingless, alone shines with the familiar greenish glitter. Even in species of which the two sexes are luminous, the female shines more vividly. It is true that there are some beetles with luminous larvæ, a fact that led Darwin [1] to remark that the production of light by insects may serve to frighten enemies. It is also possible that certain insects make use of their luminosity to light their way in the darkness. But, notwithstanding this, the sexual character of the luminous organ is so manifest in certain species that it is impossible to doubt its function as a means of attracting the male.

It is plain that an instinct, or any form of disharmony leading to destruction, cannot increase, or even endure very long. The perversion of the maternal instinct tending to abandonment of the young is destructive to the stock. In consequence, individuals affected by it do not have the opportunity of transmitting the perversion. If a majority of rabbits left their young to die through neglect the species would soon die out. On the contrary, mothers, guided by their instinct to nourish and foster their offspring, will produce a vigorous generation capable of transmitting the healthy maternal instinct so essential for the preservation of the species. For such a reason harmonious characters are more abundant in nature than injurious peculiarities. The latter, because they are injurious to the individual and to the species, cannot be perpetuated indefinitely.

In this way there comes about a constant selection of useful characters which are handed down and preserved, while noxious ones perish and disappear. Although disharmonies tend to the destruction of a species, they may themselves disappear without having destroyed the race in which they occur.

[1] *Descent of Man.*

This continuous process of natural selection, which so well explains the transmutation and origin of species by means of the preservation of useful, and the destruction of harmful, characters, was discovered by Darwin and Wallace.

Long before the appearance of man on the face of the earth, there were happy beings well adapted to the environment, and unhappy ones that followed inharmonious instincts so as to imperil or to destroy their lives. Were such creatures able to reason and talk the fortunate among them, such as orchids and fossorial wasps, would be optimists; they would declare this the best of all possible worlds, and insist that, to secure happiness, it is necessary only to follow natural instincts. On the other hand, the disharmonious creatures, those ill adapted to the conditions of life, would be pessimists. Consider the case of the lady-bird, driven by hunger and with a preference for honey, which searches for it on flowers and meets only with failure, or of insects driven by their instincts into the flames only to lose their wings and their lives; such creatures, plainly, would say that the world was fashioned abominably, and that existence was a mistake.

As for man, in which category does he fall? Is he a being whose nature is in harmony with the conditions in which he has to live, or is he out of harmony with his environment?

CHAPTER III

SIMIAN ORIGIN OF MAN

To understand human nature it is necessary first to give an account of the origin of man. This question has preoccupied mankind for ages, and for a long time it was believed that a solution of the problem was to be found in religious dogmas. Man was regarded as being of supernatural origin, the result of a special creation. Scientific criticism has now shown that there are no grounds for such a conclusion.

Darwin applied to man his discovery of the principle of natural selection and of the part it played in the origin and transmutation of species. Huxley in *Man's Place in Nature* gave an admirable review of the problem. He brought forward arguments of the highest scientific validity in support of the thesis that man is descended from animals, and that he is a mammal most nearly related to the anthropoid apes. Close examination of the structure of man has proved, in the most definite fashion, the existence of a near kinship with the higher apes such as the chimpanzee and orang-utan.

Now that all the details of the human organization have been studied, and the anatomical structures of man and the big tailless apes have been compared, bone with bone, and muscle with muscle, a truly astonishing analogy in every detail between these organisms is manifest. In the natural history of mammals the teeth play an important part as a means of determining differences and relationships. Every one knows that man has *milk teeth* and *permanent teeth*. The number

(thirty-two in the adult), the form and general arrangement of the crown, are identical in man and anthropoid apes. The differences are to be found only in minor details, such as the exact shape, relative dimensions, and the number of cusps. In a general way the teeth in anthropoid apes are more strongly developed than in man; in the gorilla the canines are much longer and the roots of the pre-molars more complex. Equally significant is the fact that all these differences are less pronounced than those which exist between the dentition of anthropoid apes and that of all other monkeys. Even in those baboons which most nearly approach the anthropoids the teeth exhibit marked differences.

In the monkeys of the New World the dentition differs still more from that of man and anthropoids. Instead of thirty-two teeth, some possess thirty-six in the adult condition, and the number of pre-molars is twelve instead of eight.

These considerations led Huxley to conclude that "it is obvious that, greatly as the dentition of the highest ape differs from that of man, it differs far more widely from that of the lower and lowest apes."

Another character which shows that anthropoids are nearer man than other monkeys is furnished by the anatomy of the sacrum. In monkeys as a whole the sacrum is composed of three, or rarely four, vertebræ, while in anthropoid apes it contains five—that is to say, just as many as in man.

The skeletons, and particularly the skulls of man and anthropoid apes, admittedly present some marked differences; but here again the differences are less than those between the anthropoid apes and monkeys.

Believers in the doctrine that the human species is essentially distinct from all the simians have laid great stress on the difference between the foot of man and

that of anthropoid apes. This difference cannot be denied. Man assumes the direct posture habitually, while apes and monkeys walk on two legs only occasionally. There has followed from this a greater development of the feet in simians. But in all essential respects the hinder limb of the gorilla terminates in as true a foot as that of man.

"The hind limb of the gorilla, therefore, ends in a true foot, with a very movable great toe. It is a prehensile foot, indeed, but is in no sense a hand; it is a foot which differs from that of man not in any fundamental character, but in mere proportions, in the degree of mobility, and in the secondary arrangement of its parts. . . . Be the differences between the hand and foot of man and those of the gorilla what they may, the differences between those of the gorilla and those of the lower apes are much greater."[1]

The comparison of muscles, the brain, and of other organs leads to the same conclusion; the differences between monkeys are more varied and greater than those between anthropoids and man. The distinguished zoologist Owen insisted on the absence in all monkeys of certain parts of the brain peculiarly characteristic of man. Such are the posterior lobe, the posterior cornu, and the lesser hippocampus. But Owen was proved wrong, and now it is unanimously accepted that the parts of the brain in question are "precisely those structures which are the most marked cerebral characters common to man with the apes. They are among the most distinctly simian peculiarities which the human organism exhibits."[1]

As regards the brain, the differences between man and anthropoid apes are certainly less marked than those that exist between the higher and lower monkeys.

The digestive tract affords another argument in favour of the affinity of anthropoid apes to man. The human cæcum is furnished with the very remarkable and strange

[1] *Man's Place in Nature.*

FIG. 3.—CÆCUM AND VERMIFORM APPENDIX OF MAN (after Ewald).

FIG. 4.—CÆCUM AND VERMIFORM APPENDIX OF THE CHIMPANZEE.

[*To face p.* 28.

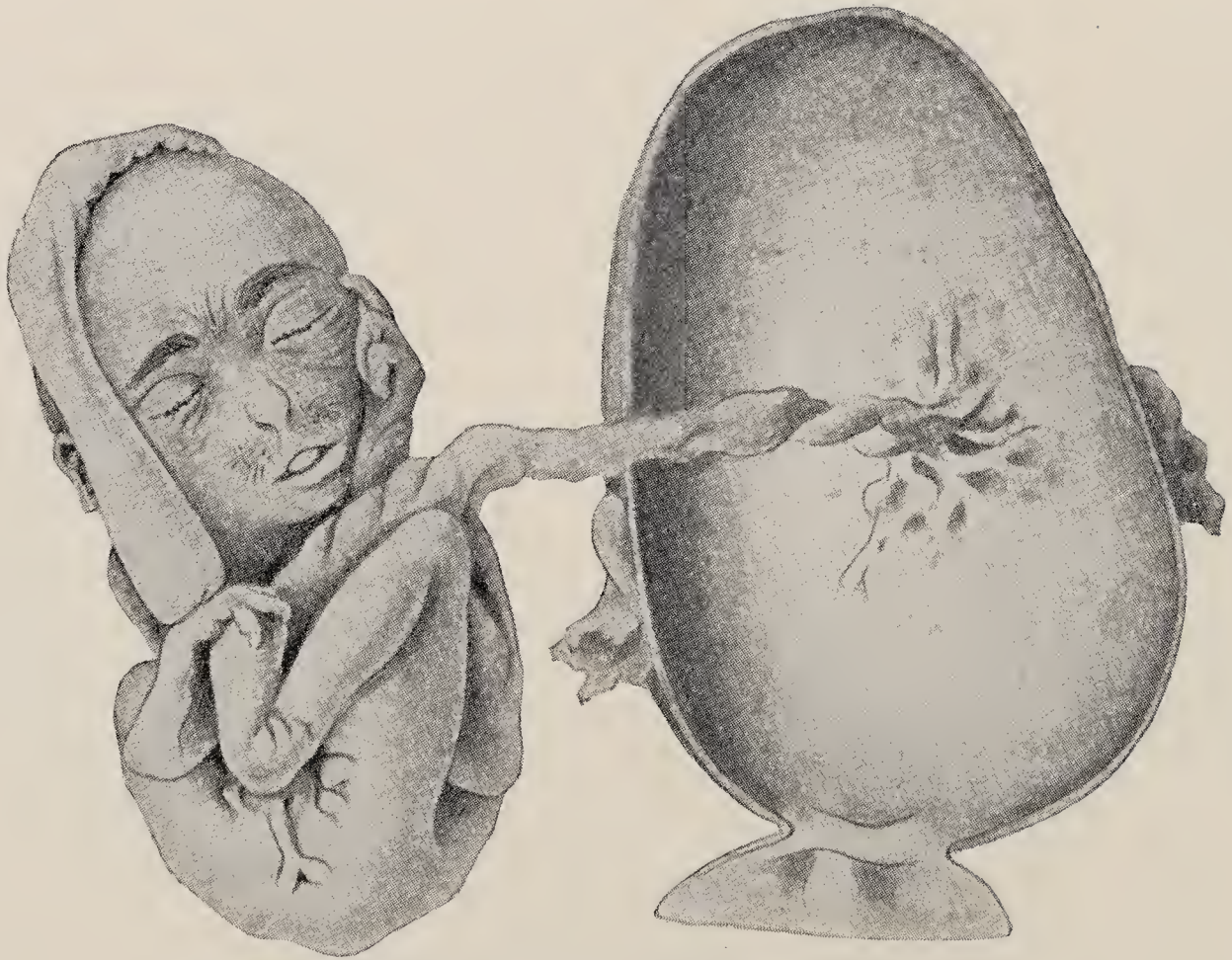

FIG. 5.—FŒTUS OF GIBBON (after Selenka).

FIG. 6.—HUMAN FŒTUS OF THREE MONTHS AND A HALF.

vermiform appendix which is often the cause of appendicitis. Now, it is quite remarkable that this organ is practically (Figs. 3 and 4) identical with the vermiform appendix of anthropoid apes. Yet none of the other monkeys presents any such resemblance to man.

It is not surprising, in the face of resemblances so numerous, that science has proclaimed the existence of a close affinity between man and the anthropoid apes. Generally, when a theory is false a new set of facts overthrows it. Attempts may be made to trim the new facts to the existing theory, but such attempts are doomed to failure, and the theory disappears. It is of special interest, then, to confront the theory of the simian origin of man with facts gathered by science since the theory was propounded.

The history of development is very often an excellent guide in tracing the relationship of organisms. It is therefore interesting to examine the established facts concerning the embryology of anthropoid apes.

The placenta often gives information of great importance in the classification of mammals. It is sufficient to glance at the zonary placenta of dogs and seals to be convinced of the relationship of these two species, which at first sight seem so different. Now the type and arrangement of the placentas, including the umbilical cords, are identical in man and anthropoid ape. Again, as regards the relation of the fœtus to its membranes the anthropoids resemble man more than they do the monkeys.

With respect to the earlier phases of embryos the similarity between those of apes and of man is very great, it is only in the more advanced stages that differentiation is marked. The fœtus of the gibbon (Fig. 5) presents the most striking likeness to a corresponding human fœtus (Fig. 6).

Later on, the characters that distinguish the highest apes from man grow more and more pronounced, the whole face becoming more prominent, and betraying a bestiality absent from the human type. None the less, the resemblance between the nearly mature fœtus of anthropoids and human embryos of about the sixth month is evident enough. The general appearance is quite enough to show the close relationship with a human fœtus of a corresponding age (Figs. 7 and 8). It is plain, moreover, that the young gorilla is more human-like than is the adult. Detailed anatomical investigation confirms this conclusion.

The skulls of the young of the different species of anthropoids not only resemble one another closely but are more human-like than are the skulls of adult anthropoids.

The data derived from embryology do not point to any one of the existing apes as the ancestor of man. They lead us to infer, rather, that man and the anthropoid apes had a common origin, and palæontological evidence must be examined to find this ancestor. Of the greatest importance was a discovery in Java, made in 1894 by Eugène Dubois. The remains, consisting of the crown of a skull, two teeth, and a femur, belonging to a creature that has been named *Pithecanthropus erectus*, are regarded by most anatomists as those of a form intermediate between man and the anthropoid apes. Darwin, seeking to broaden the basis of the argument, called attention to the close similarity of the parasites of men and apes, as evidence of a close bodily similarity of the two hosts on which they live.

When the blood of one mammal is injected into the body of another, the latter shows remarkable modifications. When there is added to a serum, prepared from the blood of a rabbit and consisting of a colourless

FIG. 7.—FŒTUS OF GORILLA (after Deniker).

[*To face p.* 30.

FIG. 8.—HUMAN FŒTUS OF ABOUT FIVE MONTHS.

[*To face p.* 31.

transparent liquid, a few drops of blood drawn from another rodent (for instance a guinea-pig), nothing particular happens. The blood of the guinea-pig preserves its normal colour, and its corpuscles remain practically unaltered. If, instead of adding guinea-pig's blood to the serum of rabbit's blood, we add a serum drawn from the blood of the guinea-pig, still no special change occurs.

If, however, a serum be prepared from the blood of a rabbit into which there had first been injected the blood of a guinea-pig, the serum shows new and striking qualities. The addition to it of some drops of guinea-pig's blood brings about, in a very short time, a changed appearance. The opaque mixture of the prepared serum of the rabbit with the blood of the guinea-pig will assume a transparent red colour. The change is due to solution of the red corpuscles of the guinea-pig in the blood-serum of the rabbit.

But this serum has still another property. If there is added to it, not pure blood but only blood serum of the guinea-pig, a precipitate is formed.

The injection of the blood of the guinea-pig into a rabbit has therefore changed the serum of the latter by introducing new properties : that of dissolving the red corpuscles of the guinea-pig and of giving a precipitate with the blood serum of the same animal.

Frequently the blood serum of animals prepared by previous injections of the blood of other species of animals is strictly specific. In such cases the serum only gives a precipitate with the serum of the species which has furnished the blood for the injections, and only dissolves the red corpuscles of this same species. But there are some instances in which a serum of a prepared animal dissolves, not only the red corpuscles of the species which has furnished the injected blood,

but those of allied species. Thus the blood serum of the rabbit, after some injections of blood of the chicken, becomes capable of dissolving not only the red corpuscles of the chicken but also those of the pigeon, although in a less degree.

Assistance is being rendered to forensic medicine by making use of this property of serums, to discover the origin of a certain blood. It is often very important to decide whether a stain was caused by the blood of man or of another animal. This can be done as follows : Human blood is injected several times into an animal (rabbit, dog, sheep, horse). Some time afterwards the animal is bled, and a clear and limpid serum, quite devoid of corpuscles, is prepared. When there is added to this serum one or several drops of human serum, it forms immediately a precipitate. In this way it is discovered whether the prepared serum is sufficiently active. It then becomes possible to recognize even dried human blood. A little of such blood is dissolved in normal salt solution, and placed in a tube containing the serum of an animal prepared by means of the injections of human blood. If a precipitate forms in the liquid in a short time, the fact indicates that the stain is really human blood.

This reaction is of great interest to us because it is of assistance in revealing the relationship between species. The serum of an animal prepared with the blood of the fowl gives a precipitate, not only with the serum of the fowl itself, but also with that of the pigeon; on the other hand, it remains undisturbed when the serum of mammals is added. The reaction indicates then that there is a marked degree of relationship between the fowl and the pigeon. Here is another example : the serum of an animal prepared with the blood of a cow gives an abundant precipitate when there is added to it a little

blood serum of another cow, but it does not produce this reaction with the serum of, say, a sheep or deer. The relationship between the *Bovidæ* and these other ruminants is then not so close as that between the fowl and the pigeon.

It has been proved that the serum of animals injected with man's blood gives a precipitate not only with this blood but also with that of the gorilla, chimpanzee, and orang-utan.

The serum of animals that have been injected with the blood of these three apes will give precipitates with the blood of the gorilla, chimpanzee, orang-utan, and man. It is therefore evident that there exists between the human species and the anthropoid apes not only an anatomical—that is, structural—analogy of body, but also a physiological and biochemical analogy—in other words, a close blood-relationship.

There is therefore no reason to doubt that man is a member of the group of primates and that he is closely connected with the existing higher apes.[1]

We have already shown that the fœtus of man and of the anthropoid apes resemble each other much more than the adult forms, and that the young of these apes also bear a greater likeness to man than do the adults. The great development of the skull as compared with the face is characteristic of young apes and of man young or old. The jaws continue to develop in the anthropoids, while in man there occurs in this respect a certain arrest of development. The hair in man also shows a similar arrest. It is especially on the back of man that this feeble development of hair occurs. As this part of the body in monkeys, on the contrary, is much more hairy than the under surface, it has been held to constitute an essential difference between man

[1] See Appendix III.

and monkeys. But embryological study eliminates this apparent contradiction. The fœtus of the gorilla possesses an almost entirely smooth back. It has true hairs only on the head, the anterior surface, and around the lips and genital organs, and as represented by the eyelashes and eyebrows. The remainder of the body is smooth or covered with down not exceeding a thirtieth of an inch in length.

The skin of the under surface, smooth around the navel, is covered with small hair more thickly than on the back. The abundance of hair on the posterior aspect of the body of monkeys is a later acquisition, which develops but tardily during fœtal life.

As regards the distribution of hair man resembles much more the embryos of monkeys than the adults. This fact, instead of shaking the theory of relationship between man and apes, furnishes strong corroborative evidence. Putting the known facts together, we may infer that man is a case of the arrested development of some simian-like creature of ancient days. Man may be regarded as a prodigy sprung from an ape-like being, born with a larger and better brain than occurred in his parents.

Certain kinds of organisms, instead of evolving at a very slow pace, spring up suddenly, and in such a case nature advances with considerable strides, as has been shown by the remarkable researches of the botanist Hugo de Vries. He cultivated for fifteen years the Evening Primrose (*Œnothera lamarckiana*). A set of flowers quite distinct from those of the original plant suddenly appeared during the first few years. De Vries at first distinguished three new species, *Œ. lata*, *Œ. nanella*, and *Œ. scintillans*, but variation becoming more and more prevalent, he ultimately separated out a dozen. These were grown from seed, and transmitted

their specific characters to their descendants, and in this way De Vries was a witness of mutations originating new species.

It is probable that man owes his origin to a similar phenomenon. Some ape-like creature, having at a certain period become varied in specific characters, produced offspring endowed with new attributes and capabilities. The brain, of abnormal size, placed in a more spacious cranium, allowed a rapid development of intellectual faculties much more advanced than those of the parents. This peculiarity was transmitted to the descendants, and, being of considerable advantage in the struggle for existence, the new race prevailed. The extraordinary development of intelligence necessarily led to perfections in the choice of nourishment, perfections which approached the art of preparing more digestible food. The jaws, under these conditions, had not such a difficult task as before, and, moreover, they were no longer required for attack or defence. They became less developed than in the true anthropoid apes.

These suggestions involve a conception of the mind that is in harmony with known facts. From time to time prodigies are born with some talent far greater than the gifts possessed by the parents. Such was the prodigy Jacques Inaudi who had an astonishing memory for figures and power of calculating rapidly. Two minutes were sufficient for him to multiply two numbers composed of seven and six figures. Other arithmetical calculations, such as the extraction of roots, gave him but little trouble.[1] Neither of the parents of Inaudi had shown in the slightest degree a calculating faculty

[1] See Appendix IV. There are many other instances of like mathematical prodigies. Dase *as a child* could correctly multiply " in his head " numbers up to six figures.—C. M. B.

like that of Jacques. His talent was developed as suddenly as the new qualities in the Evening Primrose that we have already mentioned. The first men, also, were probably prodigies born of ape-like parents.

Wiedersheim found fifteen organs which show in the human species a considerable advance on those of anthropoid apes. The chief cases are: the lower limbs well adapted for the upright posture; the strengthening of the pelvis and of the sacrum, the broadening of the pelvis of the female; the curvature of the lumbar part of the spine; the development of the buttocks and of the calves; the difference of certain muscles of the face; the nose; certain strands from the brain to the spinal cord; the occipital lobe of the brain; the greater development of the cerebral cortex; and, lastly, the considerable differentiation of the muscles of the larynx and tongue which permits speech.

Besides these more developed organs he counted seventeen disappearing ones, still able to fulfil their physiological function in a more or less incomplete manner, among them certain muscles of the leg and foot, the eleventh and twelfth pairs of ribs, the toes, the cæcum, etc., as well as not less than 107 rudimentary organs which serve no useful physiological purpose (such as the coccyx—the vestige of a tail—the thirteenth pair of ribs in the adult, the muscles of the ear, the vermiform appendix, etc.).

These organs, now useless, are the vestiges of similar but more developed organs, which fulfilled a useful function in our ancestors.

The extraordinary quantity of rudimentary organs in man furnishes another proof of his animal origin, and is of great value for the philosophic conception of human nature.

CHAPTER IV

DISHARMONIES IN THE ORGANIZATION OF THE DIGESTIVE SYSTEM OF MAN

ALTHOUGH he is a recent arrival on the earth, man has made great progress as compared with the anthropoid apes. A comparison between even the lower races of man, such as the Hottentots or the aborigines of Australia, and higher types, such as the inhabitants of Europe and of North Africa, shows what a very great advance has been made.

Human art has been able to surpass nature in many instances. No natural sound is so delightful as some of the more beautiful pieces of modern music. Even in the production of form, man has triumphed over nature. Breeders of flowers or of birds seek to produce new varieties. With this object they often frame a conception of what they desire to produce, and, so to speak, set about to realize their programme. They prepare ideal images to serve them as models. By artificial selection they have produced birds and flowers more beautiful than any found in nature.

In regard to the human body, attempts have been made to surpass nature and to represent a body corresponding to an artistic ideal. To arrive at something more beautiful than man, the wings of birds or the characters of some other creatures have been added to his presentment. Such attempts have had no other result than to show that the human form, as created by nature, cannot be surpassed. But the beautiful form of the human body appears only in youth and in maturity.

In old age, the bodies of men and women are generally ugly, and in extreme old age it is almost impossible to see the traces of former beauty.

The human skin is covered with little hairs, the history of which is interesting. In one stage of embryonic life nearly the whole of the body is clad with hairs. This covering is known as the *lanugo*, and consists of strands of hair, disposed very regularly all over the body, save on the nose and the hands and feet. There is no doubt but that this is functionless, and is no more than an inheritance from the old ape-like condition. Later on, it disappears and is replaced by the ordinary downy covering of the body. In adult life, and particularly in old age, the hair of the second coat tends to grow very long and so to form a covering that is neither beautiful nor useful. We may take this as a first example of a disharmonious condition in the human body. Such hair, incapable of protecting the body from cold, survives merely as an ancestral relic and may become a nuisance.

The human skin is constantly exposed to microbes; and the follicles of the hairs, in which they lodge, form receptacles very favourable to their multiplication. In the hollows of the follicles, certain microbes, as for instance *Staphylococci*, multiply rapidly and give rise to acne and to pimples.

In the human race, intelligence—that is to say, the activity of the brain—supplants many other functions, and man through his invention of clothing is much better able to protect himself against the inclemencies of weather than were his furry ancestors.

Although man can cope with the total loss of teeth, it cannot be said that natural teeth are useless. None the less, a study of the human dentition reveals that this set of organs is out of harmony with the fundamental

needs of our race. The monkeys of the Old World (*Catarrhines*) already exhibit a tendency to reduction in the number of teeth, for while those of the New World (*Platyrrhines*) may possess thirty-six teeth, the Old World forms do not normally possess more than thirty-two in all. Among gorillas and orangs individuals with a fourth pair of molars, bringing up the number of teeth to thirty-six, are not rare; additional molars being present in about twenty per cent. of orangs. On the other hand, in the case of the chimpanzee and the gibbon, the third pair of molars differ from the others in smaller size and occasional absence. This reduction is to be associated with the smaller jaws and less powerful mastication of these anthropoids.

Cases of supplementary molars are very rarely present in man, except in the lower races, such as negroes, Australians, and natives of New Caledonia. On the other hand, absence of the third pair of molars, or wisdom teeth, is quite frequent, especially in the white races. The loss of the wisdom teeth is on the whole an advantage, as their power of mastication is feeble. These teeth are cut very late, often not appearing until the thirtieth year and sometimes being delayed to extreme old age.

Even if they were only useless, the wisdom teeth would furnish an instance of disharmony in the human body. But these teeth are sometimes a source of trouble which may lead to disease and even to death. The origin of many malignant growths of the jaw may be traced to the socket of a wisdom tooth.

There is no useful function of these teeth to set against their disadvantages. It was our remote ancestors, masticating hard food, that had the advantages of these additional teeth. In man they are rudimentary organs, and provide another proof of our simian origin.

The vermiform appendix is another rudimentary organ

in the human body. It consists of a thick wall containing glands, a muscular layer, and lymphoid clumps. That it performs no function useful to man is made clear by the existence of undisturbed health in the numerous persons from whom it has been removed.

On the other hand, the opening into the appendix in adult man is frequently closed, so that there is no connection between it and the general digestive cavity. In young persons and infants, however, the aperture of the appendix is usually open. It is logical to conclude that in the human being the function of this organ is either absent or very slight.

Even in the anthropoid apes the appendix appears to be a rudimentary structure, with a function at most accessory to that of the lymphoid glands. In lower Old World monkeys the vermiform appendix does not usually exist, cases such as that of *Cercopithecus sabaeus*, in which it is present as a little boss, being rare. The organ is a very ancient and primitive part of the constitution of mammals; it is necessary therefore to seek for its purpose still lower in the scale of life. In some herbivorous creatures the cæcum is large, and ends in a portion richly provided with lymphoid tissue similar to that of the vermiform appendix. The rabbit and certain marsupials are good examples. Undoubtedly, in their cases, the portion of the digestive canal which corresponds to the appendix of man is active in the digestion of vegetable matter.

Rudimentary organs for the most part display a congenital lack of the power of resistance, and, as Darwin suggested, for this reason they are frequently the seats of disease.

The vermiform appendix is not the only part of the digestive canal that is out of harmony with the maintenance of life and health. The cæcum itself, of which the

appendix is only a portion, is also degenerating in the human body. The human cæcum, in fact, is very little developed in comparison with the cæcum of most herbivorous animals in which it is a true organ of digestion. In the human embryo the cæcum and the appendix are relatively better developed than they are in the adult.

Disharmony is exhibited in the body of man not only by rudimentary organs such as the wisdom teeth and the appendix, or by degenerating organs such as the cæcum, but also by the large intestine which is in great measure a useless and superfluous structure bequeathed to us by our ancestors. So far as digestion goes this part of the alimentary tract is of little importance. And so it is not astonishing to find that the removal of nearly the whole of the large intestine can be supported well by man.

The fact that human beings are able to live for some thirty years in the absence of a large intestine is good proof that the organ in question is not necessary to man, although it has not yet become rudimentary. In this case again, to find when this structure was of full use we have to go to our remote ancestors.

The large intestine is much better developed in most herbivorous mammals than it is in carnivorous forms. Although it is useless in the digestion of animal food, it has an undisputed importance in the digestion of vegetable matter. It has a very large calibre in herbivorous creatures, and the voluminous cavity contains quantities of microbes which are able to digest cellulose. As cellulose is a material that resists the ordinary processes of digestion, it is easy to see the advantage derived from the harbouring of the microbes. In the horse, the rabbit, and some other mammals that live exclusively on grain and herbage the large intestine is necessary for normal life.

On the other hand, the large intestine discharges a function similar to that of the urinary bladder. The urine, which is being excreted continuously by the kidneys, accumulates in the reservoir provided by the bladder. Similarly the waste materials from the processes of digestion accumulate in the large intestine and remain there for a longer or shorter period.

In studying the natural history of the large intestine, it is striking that this portion of the gut is well developed only among mammals. These animals, for the most part, lead an extremely active terrestrial life. Most of them have to move about very quickly, the predacious forms in pursuit of their prey, the herbivorous forms to escape from their enemies. In such a mode of life, the need to stop in order to empty the intestines would be a serious disadvantage, and the possibility of retaining the dejecta in a large reservoir would be very useful.

Such are the causes that have determined the growth of the large intestine among mammals. Birds, which live, so to speak, in the air, and which do not need to arrest their locomotion in order to void their excreta, have no large intestine. Reptiles and amphibia, although they live a terrestrial life, do not require a voluminous large intestine, and such is not found among them. These animals do not have a fixed temperature; they are what we call "cold-blooded," and in consequence are small eaters. Most of them are sluggish, and do not lead an active existence like that of mammals.

In mammals the large intestine is the reservoir of the waste of the digestive processes, and this waste stagnates long enough to putrefy. The products of putrefaction are harmful. When fæcal matter is allowed to stagnate in the intestine, as in constipation, certain products are absorbed by the organism and produce high temperature and poisoning (auto-intoxication), often of a serious

nature. The organ is the seat of many grave diseases, among which dysentery and cancer are notable. In fine, the presence of a large intestine in the human body is the cause of a series of misfortunes.

It is not surprising to find so many instances of useless or harmful organs in the alimentary tract. Our ancestors were creatures that fed on crude and rough materials, such as wild plants and unprepared flesh. Man has learned to cultivate plants that are digested easily, and to prepare his meats in such a fashion as to be readily digested. The organs that were adapted to the mode of life of the animal predecessors of man have become to a large extent superfluous. Many creatures that have found the opportunity of obtaining their nutriment in a highly digestible condition have lost, more or less completely, the digestive organs. Many parasites are instances of this, as for example the tape-worms, which live in the human digestive tract, bathed by a nutritive fluid which they absorb directly; they have lost the digestive tract completely.

In the case of man such an evolution has not occurred, and there remains in the body a harmful organ like the large intestine. In consequence; it is impossible for him to take his nutriment in the most perfect form. If he were only to eat substances that could be almost completely absorbed, the large intestine would be unable to empty itself, and serious complications would be produced. A satisfactory system of diet has to make allowance for this, and in consequence of the structure of the alimentary canal, has to include in the food "roughage," that is, bulky and indigestible materials.

At this point I may refer to a topic of considerable general interest. Animals, in the choice of food for themselves or for their young, are guided by a blind and innate instinct. As I have shown in my second chapter,

creatures like the fossorial wasps select only particular species of spiders or insects. Instinct directs them to the kind of food best suited to the wants of their progeny. Bees are attracted by the sweet juices of flowers; the silkworm instinctively devours the leaves of the mulberry and rejects most other plants. In higher animals, instinct plays the chief part in the choice of food. The difficulty of getting rats to eat poisoned food is well known; an instinct warns them of the danger of the material offered to them. In the same way dogs will often refrain from food that has been poisoned.

Every one has seen the minute attention bestowed by a monkey on food before beginning to eat it. It turns over what is offered, smells it carefully, cleans it, and, before beginning to eat, subjects it to an examination that seems to us ridiculous. Monkeys often throw away food without even biting it. None the less, in spite of an instinct so highly developed, monkeys do sometimes poison themselves with dangerous substances, even when these exhale a strange odour. I have seen monkeys poisoned by the phosphorus of matches and by iodoform which they had contrived to steal.

In the case of man, aberrations of instinct in the choice of food are common. As soon as babies begin to walk, they lay hold of everything and try to eat it. Bits of paper, lumps of sealing-wax, the mucous matter from the nose, all appear to them to be things to eat. Constant guard has to be kept to prevent them from doing themselves an injury. Fruits and berries they cannot resist. Cases of poisoning very naturally are extremely frequent, and every one must know instances.

While the large intestine, acting as an asylum of harmful microbes, is a source of intoxication from within, the aberrant instinct of man leads him to poison himself from without with alcohol, nicotine, opium, and morphia.

The widespread results of alcoholism show plainly the prevalent existence in man of a want of harmony between the instinct for choosing food and the instinct of preservation.

The digestive apparatus, then, affords abundant proof of the imperfections and disharmonies of our nature.[1]

[1] See Appendix V.

CHAPTER V

DISHARMONIES IN THE ORGANIZATION AND ACTIVITIES OF THE REPRODUCTIVE APPARATUS

The digestive organs are not alone among the parts of the human body in exhibiting a greater or lesser disharmony. Helmholtz stated that the optical study of the eye brought complete disillusion. "Nature," he said, "seems to have packed this organ with mistakes, as if with the avowed purpose of destroying any possible foundation for the theory that organs are adapted to their environment." Other organs by means of which we are conscious of the outside world also present natural disharmony. Therein lies the cause of our want of certainty about the sources of our perceptions. Memory, the faculty that registers our mental processes, becomes active much later than other faculties lodged in the brain. If the new-born child were relatively as well developed as the young guinea-pig, it is probable that we should know far more as to the history of our consciousness of the external world.

A detailed investigation of the male and female human reproductive organs shows that these contain portions of extremely ancient origin, and portions that have been acquired recently. The internal organs display traces of a remote hermaphroditism. In the male there occur traces of the female apparatus, rudiments of the uterus and Fallopian tubes. In the female, on the other hand, rudiments of the male structure persist. These traces date very far back in the history

of the race, for they occur also in most other vertebrates. The facts seem to indicate that, at a very remote period, the ancestral vertebrates were hermaphrodite, and that they became divided into males and females only gradually, still retaining in each sex traces of the other sex. Such traces occur frequently, even in adult man, in the form of rudimentary organs known as the organs of Weber, of Rosenmüller, and so forth. The rudiments not only are functionless but sometimes, as frequently happens with atrophied structures, form the starting-point of growths that interfere with health. Thus the hypertrophy of a part of the male prostate gland (the organ of Weber) brings about the formation of a *uterus masculinus*, and so produces a sort of abnormal hermaphroditism. The rudimentary organs in the male reproductive apparatus are frequently the starting-points of hydatid cysts. In the female, cysts such as those of the *parovaria* are produced by the proliferation of rudimentary structures which may become malignant.

A comparison of the rudimentary organs in the human reproductive apparatus with those in the similar structures of lower animals shows that many relics have degenerated further in man than in other animals. Thus the duct of the embryonic kidney (known as the Wolffian body) is of rare occurrence in adult man, although it is retained throughout life in the case of some herbivorous animals, in which it is known as Gaertner's duct.

I have already pointed out that all attempts to demonstrate the presence in the human brain of parts that were absent in the simian brain have failed. It is a curious fact that man displays a more marked difference from monkeys in the structure of the reproductive system than in the structure of the brain. There is no *os penis* in man. This bone, which facilitates intromission, occurs in many vertebrates, not only among rodents and

carnivora, which are widely separated from man, but in many monkeys, and most notably in anthropoid apes. For some reason impossible to establish, man has lost this bone. It may be that certain ossifications of rare occurrence may represent an atavistic inheritance from our remote ancestors.

In the male sex the difference between man and the anthropoid ape is the loss of an organ; in the female sex it is the acquisition of an organ. The hymen, the physical indication of virginity, is peculiar to the human race. That organ would serve the purpose of those disputants who make every effort to discover the existence of a structure peculiarly human, far better than the posterior lobe of the brain, or the hippocampus minor. Bischoff has determined its absence in the anthropoid apes, and his result has been confirmed by other observers. Deniker failed to find it either in the fœtal gorilla or in the young gorilla. In the case of the fœtus of the gibbon, he found a slight elevation round the entrance to the vagina "which might be homologized with the hymen," but which, however, was not the membrane in question. Deniker himself decided that the "membrane was absent in anthropoid apes at all ages." Wiedersheim, in his summary of the organization of the human body, also sets down the fact that "in monkeys a hymen is not present."

The fact that this structure appears late in the development of the female fœtus bears out the supposition that it has been acquired recently by the race. According to several observers, who agree in this matter, the membrane does not develop until at least the nineteenth week of fœtal life.

The hymen sometimes plays a large part in family and social relations, and, regarded as the evidence for virginity, has had moral significance bestowed on it. A

minute examination of this structure is frequently a part of the judicial procedure in cases of supposed rape and so forth. The destruction of the hymen during coitus has led to the death of many women.

From our point of view, however, it is the possible physiological function of this structure that is interesting. It seems impossible to conclude otherwise than that in existing races it has practically no functional value. Its atrophy as the result of sexual congress not only is no bar to sexual relations, but removes an unpleasant impediment. In many races the structure is removed as soon as possible. In some parts of China it is destroyed as part of the toilet of young children, and indeed many Chinese physicians are ignorant of its existence. A similar state of affairs occurs in some parts of India. In Brazil, among the tribe of Machacuras, virgins, in the European sense, do not exist, for the mothers destroy the hymen in female children soon after birth. In Kamchatka the aborigines regard it as disgraceful to be married with the hymen intact, and the mothers operate on their daughters. Among other races, again, the disagreeable duty of defloration is assigned to special persons. Among the natives of the Philippines there formerly existed well-paid public officials the duty of whom was to destroy the virginity of the girls and so to make marriage pleasanter for the husbands. A similar custom occurs among the inhabitants of New Caledonia, and Moncelon states that there virginity is held in little esteem. "I have proof of the curious circumstance," he wrote, "that when a husband shrinks from destroying the virginity of his wife, he employs someone from a regular profession to take his place."

Such examples, selected from among many, may be taken as proof that even such a peculiar and recently acquired organ has not a physiological use.

On the other hand, especially among Christians and Mahomedans, the existence of the hymen in an intact condition is regarded as very important. The ancient Jews began to set a high value on virginity. According to the old Mosaic law, if, at the time of her marriage, a young girl were found to be no longer a virgin, "Then they shall bring out the damsel to the door of her father's house, and the men of her city shall stone her with stones that she die; because she hath wrought folly in Israel, to play the whore in her father's house" (Deut. xxii. 21). The religions that have sprung from Judaism have retained this old view of virginity, although in an attenuated form. Among some Christian peoples, material proofs of virginity at the time of marriage are demanded, and among Mahomedans such proofs are exhibited to friends and relations on the day after marriage. However, the actual defloration is not always left to the husband, but, among Arabs and Copts and the natives of Egypt, the operation is performed by a specially selected matron.

It is plain, then, that this membrane is of no direct service in sexual congress. It may even give rise to more or less serious misfortune. Thus when it is unusually rigid, the adjacent perineum may be torn and the results may be disastrous. Occasionally the rupture of an abnormally vascular membrane may give rise to bleeding of a prolonged and even fatal character.

I have already mentioned that among some races a rigorous toilet involves the destruction of the hymen. It is plain that the existence of the membrane interferes with strict hygiene of the vagina, especially at the periods. Probably some blood is retained by the membrane and furnishes a soil for microbes that may be dangerous to health.

What, then, can be the meaning of this organ, useless

as it is for the sexual functions, sometimes dangerous to health, an organ that is no ancestral heritage and that must be destroyed by the act of sexual union? Formerly, when it was accepted that characters acquired in individual life could be transmitted to offspring, the question was asked why this membrane had not disappeared. The instance was one of those which helped to overthrow the dogma of the inheritance of acquired characters.

Although it is useless to existing man, this organ may yet come to be explained by science. As yet we have to fall back on suppositions. The hypothesis which seems most probable is that, in the earlier period of the existence of the human race, sexual relations were begun at a very early age, before the male organs were mature. In such circumstances the hymen would not only not have been a barrier, but would have made congress more satisfactory. Gradually the hymen would have become dilated without being torn, until it was capable of admitting the adult organ. This hypothesis implies that in early times the membrane was not brutally torn, but that it was gradually dilated, and that violent rupture is a modern necessity. In support of the hypothesis it may be mentioned that among certain living races sexual union begins at a very early age. In Ceylon, marriage may take place when the boys are from seven to ten years old and when the girls are from four to eight. After the actual wedding ceremony the bride returns to the house of her parents, and it is only a few years later, when she is adult, that she goes to her husband.

Among the Vedas, a low caste of tropical India, boys marry at the age of from fifteen to sixteen years, certainly before the sexual organs have attained their full dimensions. In Madagascar, in the beginning of the seventeenth century, it was the custom for boys to marry

at an age of from ten to twelve years. The natives of New Guinea marry their boys at the age of fourteen to fifteen. Even in England a law existed until recently permitting marriage to boys fourteen years old.

The hymen is not always ruptured in sexual congress; about seventeen per cent. of women in their first confinements are found to have the hymen intact. Since provision for children has fallen on fathers these have taken to deferring marriage to a later age than when children were left to the mother. That is the probable reason why there are now fewer married boys. Thus, formerly, the proportion of women who at the first childbirth still possessed unruptured hymens was much greater, and it is not difficult to suppose that in still earlier times such a condition was normal. It is plain that there is here an instance of a very recently acquired disharmony.

The male homologue of the female hymen is a little fold that hinders the mingling of urine with the seminal fluid during emission, and that is known to anatomists as the *caput gallinaginis* or *colliculus seminalis*. It is very much smaller than the hymen, so that we cannot regard the latter as a rudimentary homologue of a useful organ. However, the prepuce of the male is a clear instance of the presence in the male organs of useless parts. It is removed by circumcision among very many races, such as the Hebrews and Arabs, and other Mahomedans, and among Persians, negroes, Hindus, Tartars, and its absence seems to bring about no inconvenience.

CHAPTER VI

DISHARMONIES BEFORE AND AFTER MARRIAGE

NOTWITHSTANDING their imperfections, the human organs of reproduction are able to fulfil their functions. A close scrutiny, however, shows that there are many sides on which they are disharmonious or badly adapted.

The occurrence of bleeding is usually a sign of disease. Bleeding from the nose, the lungs, intestines, or kidneys is an indication of disease more or less serious. Discharge of blood from the female reproductive organs may also be an indication of disease, as for instance when due to tumours of the uterus. The only exception to the rule is the periodic flow in the case of women, by which they lose from three-and-a-half to fifteen ounces of blood. There is something paradoxical in such a physiological occurrence, and it deserves minute consideration.

These periodic losses, unlike the possession of a hymen, are not a peculiarity of the human female. "Heat" in lower animals is analogous, although in that case the chief indications are swellings of the mucous membrane with a slight discharge of fluid, hardly tinged with blood. The state indicates the awakening of the sexual instinct and readiness for coition. Among monkeys there has been observed a flow much more closely resembling that of women. In the case of macaques and cercopitheci, it has been observed even that the flow is monthly.

Among 230 females of *Macacus rhesus*, of which the greater number were adult or nearly so, seventeen displayed signs of menstruation, consisting of a swelling

of the genitalia accompanied by the discharge of a pale and viscid fluid. Usually the flow assumed a pale rose tint, due to the presence in it of blood corpuscles, and cases where it was highly coloured were rare.

Although they are distinctly analogous to the menstrual flows of women, these occurrences in monkeys are distinguished by the predominance of the swelling of the genitalia, the viscid character of the discharge, and the relative absence of blood. They present a condition intermediate between the " heat " of lower animals and the human phenomena.

In anthropoid apes—for instance, the chimpanzee—a similar menstruation has been observed. " At this period," wrote Hartmann, " swelling and reddening of the genitalia occurred. The labiæ majores, which are usually inconspicuous, enlarged greatly, and a similar increase took place in the labiæ minores and the clitoris."

In the case of women, swelling of the genitalia is very slightly marked, and the chief occurrence is the flow of blood. It is plain, then, that something new has been acquired in the menstruation of women.

The condition of the flow at the present time is probably the result of modifications acquired recently in the history of the race. Among primitive peoples sexual union took place at a very early age, and pregnancy occurred before menstruation. The latter did not appear during pregnancy nor in the time of suckling, and probably the latter was hardly over before a new pregnancy had occurred. In that way there was no opportunity for the onset of menstruation.

The human capacity for procreation throughout the year made the race extremely prolific. Probably this prolificness is the reason why man has spread over the surface of the earth, and has multiplied so enormously,

in spite of the barriers to his progress and the high rate of mortality to which he is subjected.

Instances are known from recent observation of pregnancies occurring before the onset of menstruation. Among the Guatos of Paraguay married women not more than five to eight years of age have been met with, and these must have married before menstruation. Among the Vedas of tropical India, girls marry before they are nine years of age, and have relations with their husbands before sexual maturity. In Chiras in Persia, girls marry before puberty, and while their chests are still flat. In Syria, according to Robson, girls marry at the age of ten, and so before puberty. Du Chaillu related that the Achira of West Africa did not defer marriage until after the appearance of puberty. Abbadie, while on his voyage in Nubia, found that men bought young girls and had sexual relations with them before the time of menstruation. Among the Atjeh of Sumatra, girls marry at an age certainly before that of puberty, as they have hardly lost their first set of teeth. Although the husbands are a few years older, they are still unfitted for sexual union. The couples sleep together, and attempt sexual union before they are fitted for it. Among the islanders of Viti, again, marriage takes place before puberty.

The ancient Hindoos married at a very early age. Bötlingk quotes from the Sanskrit poems in which hell was awarded to the fathers of girls who had not been married when puberty came on. In other verses it was written that not only the father but also the mother and the elder brother were to be carried down into hell if the daughter began to menstruate before she had been married; the girl herself was to descend to the lowest degree of Sûdrâ, and was never to be taken as a wife.

There is no doubt as to the possible fertility of

marriages contracted at these early ages. Polak gives examples taken from Persia. It is not necessary for impregnation that it should have been preceded by a menstrual flow. Facts making this clear have occurred not only in warm climates but in our own latitude. Rakhmanoff, in Russia, attended in childbirth a woman not more than fourteen years of age, of poor constitution, and badly nourished, and with features still infantile. Menstruation had not yet taken place; the confinement was normal.

It is reasonable to suppose that in former times these early marriages of girls under the age of puberty were more common, if indeed they were not customary. In such circumstances menstruation would have been a rare phenomenon.

It must be remembered that the examples of menstruation observed in the case of monkeys were taken from creatures living in abnormal conditions, isolated in zoological gardens and passing their lives in captivity. It is highly probable that the periods as they exist to-day, with copious sanguineous discharge, are a recent acquisition of the human race.

As he emerged from the primitive condition man had to restrain his prolificness. The history of savages and of civilization shows that progress and culture have been accompanied by a rise in the age for marriage. In this way the menstrual periods could develop without check, and attain the present condition. In these circumstances it is not wonderful that menstruation should appear so abnormal and even pathological. A copious discharge of blood, preceded and accompanied by pain and by nervous and mental distress as so frequently happens, has no apparent kinship with the processes of normal life.

It is now easy to see why among so many races there

are special rules made for women during this period. Most of the races of the earth regard menstruating women as impure; the occurrence is so widespread that it is unnecessary to adduce particular cases, but a few with some point of special interest may be noticed. Thus, among the Hindoos a high-caste woman is regarded as a pariah in the first day of the period, and as one of the murderers of Buddha on the second day. Among many races a woman in this condition is forbidden to come near men, or to touch a number of objects, as she is regarded as capable of setting up many diseases and of doing serious damage.[1] The Germans of the eighteenth century believed that the hair of a menstruating woman buried in manure would engender snakes.

It is not surprising that the origin of menstruation has been attributed frequently to evil spirits. The Iranians held that it appeared first in Dchahi, the goddess of immorality. Such opinions implied vaguely that there was something abnormal in the process. The history of the evolution of menstruation explains well the origin of such a notion.

Another bizarre and apparently abnormal feature of the reproductive processes receives explanation in the history of its evolution. The feature in question is the painfulness of childbirth. It is truly astonishing and singular to find a phenomenon essentially normal from the point of view of physiology accompanied by pain of so marked a character. No doubt other animals suffer during labour, but among the mammalia woman undergoes the severest pain.

Observations made on several Europeans who have

[1] Quite recently I met a farmer in the New Forest district who was convinced that bacon touched by a woman " during her periods goes bad " and at once becomes unfit for human consumption.—C. M. B.

been brought to bed at an abnormally early age have shown that, contrary to all expectation, parturition was easy and the sequelæ normal. The daughters of the colonists in the Antilles were accustomed to marry at very early ages. A young woman of that region had her first child when she was twelve years and a half of age, and the birth lasted no more than a quarter of an hour and was painless.

On the other hand, certain facts show that too young mothers are subject to a very heavy rate of mortality during childbirth, and soon after it. The most salient fact in this connection is furnished by Hassenstein, who has stated that the mortality of labour cases in Abyssinia is thirty per cent., and who has attributed this death-rate to the circumstance that marriage takes place before the body of the woman is sufficiently developed. In British India the disadvantages of precocious marriage have been repeatedly urged to the present day.

Most modern authorities agree that women from twenty to twenty-four years of age are best fitted for labour—that is to say, show the lowest rate of mortality during labour or as a result of labour. Such women are also the most fertile.

A most striking instance of disharmony is the order of development of the human reproductive apparatus. Puberty declares itself in a woman by the beginning of menstruation at a time when girls still possess infantile characters and when the bones of the pelvic basin are not yet fully developed. Obviously we have here a disharmony between puberty and the general maturity of the body. This disharmony becomes still more evident upon a closer examination of the phases of development of the different reproductive functions. In the human race, reproduction is brought about by the union of the sexes suggested by sympathy or mutual love. The sexual

union makes it possible for the spermatozoa to reach the eggs and fertilize them by passing into them. It might have been expected that the different steps in the process would have been attuned so as to act in harmony. As a matter of fact there is no such relation; the different factors of the sexual function develop independently and unharmoniously.

Love and the sexual sense in the human race appear before the other factors in the process. Little boys frequently exhibit amorousness toward women, and are capable of being strongly affected by jealousy and by desire of exclusive possession of the coveted woman. Dante, at the age of nine, fell in love with Beatrice; Casanova was in love when he was little more than six years of age, and Lord Byron was in love with Mary Duff at the age of seven.

Sexual excitability appears at an age when there is no question but that the sexual elements are undeveloped. In infants still in the cradle observers have noticed movements and attitudes showing the presence of sexual excitability. Later on in life the development of this excitability is more common, and is practically universal among boys long before the spermatozoa are ripe.

This disharmony is the cause of onanism, which is common everywhere among boys. Before ordinary sexual congress is possible for them, boys experience the characteristic pleasure of the sexual sensations, and by a kind of natural instinct learn self-gratification. Onanism is sometimes defined as a " gratification of the sexual desire by unnatural means." But it is man's constitution itself that permits the development of the sensation precociously—that is, before the development of sexual maturity; such sexual aberrations are not unnatural as they occur among animals.

In the case of young boys the habit is so common that

few are able to say truthfully that they have avoided it completely. Christian says: "Onanism among certain peoples, at certain times, has been recognized as an ordinary event." The cause of this habit is undoubtedly traceable to a natural disharmony in the human constitution—the premature development of sexual sensation. Among the most civilized races and the lowest savages this mode of satisfying the premature demand is equally common.

It is to be noticed that onanism is more common and earlier developed in the male sex. The development of sexual irritability in the female occurs very irregularly. In some races onanism is so much a custom among little girls that no attempt is made to conceal the practice. This occurs, for instance, among certain Hottentot tribes, and is referred to openly. Similar instances occur elsewhere, though in most races the practice is thought wrong, and is concealed as much as possible.

Among girls, onanism is less frequent than in the case of boys, a circumstance in relation with the fact that sexual sensation usually appears much later in the female sex.[1] It is almost a general rule that girls who have arrived at sexual maturity have not acquired sexual irritability, while to many it comes only gradually after marriage. Sometimes it does not occur until after the first child has been born. On the other hand, love begins very early in young girls, although it long retains a platonic character and is not associated with sexual sensation until much later.

The maturity of the spermatozoa comes long after the development of sexual irritability and of love. None the less, it comes before the male organism as a whole is actually ready. It happens, in consequence,

[1] There would seem to be similar differences between the sexes in the case of monkeys.

especially among the highly civilized peoples, that marriage is impossible at the right time. The youth has his education to finish, his profession to choose, and he must be ready to support children before he is able to marry. As civilization advances, the age of marriage becomes later and later. In the case of Europeans, sexual maturity occurs in the male at the age of twelve to fourteen years, while the average age at the first marriage is shown in the following table :—

Table of Ages at First Marriage

Nationality.	Age in years of males.	Age in years of females.
English . . .	25·94	24·69
French . . .	28·41	25·32
Norwegians . . .	28·51	26·98
Dutch	29·15	27·78
Belgians . . .	29·94	28·19 [1]

These figures show clearly what a gap there is between the coming of sexual maturity and the age at which marriage can be undertaken.

The decay of the reproductive functions shows a series of disharmonies similar to those that occur during development. Spermatozoa continue to be formed throughout the greater part of the life of a man, and may still be found even in very old men. They have, for instance, been discovered in abundance in one man aged ninety-four, and in another aged 103. But the presence of ripe spermatozoa is not the only condition necessary for functional virility. Old men are frequently incapable of making normal use of the spermatozoa that are produced. This brings about discomforts in the sexual functions which, however, do not prevent the specific sensation and desire until extreme old age. Doctors in hospitals for old men have noticed to what an

[1] See Appendix VI.

extent they are engrossed by sexuality. Even ancient authors have alluded to the amorous sentiments of old men being diverted into a perverted attraction to youths.

Sexual irritability and amorousness not only appear before sexual maturity and general fitness of the organism for marriage, but they remain after the disappearance of these. It is remarkable how profound is the difference between the disharmonies of the reproductive functions in man and the perfect condition of adaptation of the same functions in the higher plants. In the case of the latter the arrangements are complicated on account of the necessary mediation of insect life; nevertheless, the perfection of the adaptation is remarkable. At the exact time when the reproductive products are ripe, petals open, nectar is secreted, and odours agreeable to insects are disseminated. Attracted by the scents and colours, the insects visit the flowers in quest of pollen or nectar, and, becoming dusted with pollen, carry it to the stigmas of the next flowers they visit. As soon as fertilization has taken place the petals fade, the scents are no longer produced, and the insects cease to visit the flowers to which they are no longer necessary.

It is not surprising that the disharmonies in the human reproductive apparatus are a frequent source of trouble. Little children, in whom sexual irritability has awakened prematurely, learn to satisfy it by means called "unnatural." It is in early infancy that this aberration merits the evil reputation that it has acquired, an evil almost entirely a consequence of the unripeness of the organism for sexuality. Happily these occurrences are very rare.

Other unfortunate results come from the ripening of the sexual products before the organism is ready for marriage, and before the character has been formed. As men cannot contract marriage before they are

ready for it, irregular and frequently harmful sexual aberration may occur.

The survival of this specific irritability until too late a period of life is another source of disaster. Old men who can neither excite passion nor satisfy it, often become victims of their own amorousness and unassuaged passions. Sexual irritability and desire may be retained after complete atrophy or removal of the testes from men or the ovaries from women.

Disharmony of sexuality may also occur between persons of different sexes. The fact that sexuality is usually more precocious in the male sex often produces a disharmony in the case of married persons. Again, while a woman is still in full possession of this specific irritability, the appetite in the man may be on the wane. From this disharmony there often follows conjugal infidelity or passion between persons of the same sex.

Schopenhauer wrote as follows: "That Nature herself may produce a condition totally opposed to the natural function offers a paradoxical problem."[1] When we consider the disharmonies in the development and activities of the sexual functions the apparently paradoxical aberrations are understandable enough.

The existing disharmony gives rise to many evils from earliest youth to advanced age, and consequently it is not surprising to find that religions have denounced sexuality more or less severely. In practically all religions it has been considered a homage to the Deity to refrain from sexual intercourse. Religions have found cause for denouncing human nature as vile simply because sexual disharmonies lead to aberrations.

[1] *The World as Will and Idea.*

CHAPTER VII

DISHARMONIES IN THE FAMILY AND SOCIAL INSTINCTS

As the functions of reproduction are seated deep in the organic world and none the less present cases of striking disharmony in mankind, it is not surprising to find similar want of adaptation in the family instincts of man, as these instincts have been acquired more recently and are less widespread in the living world.

Though the lower animal world provides many examples of onanism and of aberrations of sexual congress, it presents no cases in which pregnancy is destroyed by aberrant instincts.

To the human race belongs the distinction of having invented modes of sexual congress which are necessarily barren. No doubt the loss of the *os penis* has made such occurrences more easy, as the presence of that bone would render sudden interruption of coition difficult. But there are many ways in which the spermatozoa may be prevented from accomplishing their function, and these are so common and so familiar that it is unnecessary to enumerate them. In civilized countries procreation is limited chiefly by such means. In its early days, the human race must have been distinguished by its unusual procreative capacity, but with the growth of civilization many devices have been employed to limit the number of offspring.

Savages and races of low civilization have recourse to artificial abortion rather than to means for preventing fertilization, and abortion is almost universal among them.

Deliberate abortion with the object of limiting the

number of children is customary all over the globe. In most primitive races and among peoples of low civilization it is practised openly. Many of these peoples have adopted the custom of limiting the family to two children by procuring abortion in subsequent pregnancies. The aborigines of Kaisar and of the islands of Watubela observe the rule strictly. Among the natives of the islands of Aaru it is rare to find more than three children in a family, because any others are destroyed by artificial abortion.

A similar custom is widespread in India, being quite as common among the Hindoos who are ruled by England as among independent races. In the peninsula of Kutch, women frequently procure abortion, and one woman boasted that she had made use of the practice five times. Abortion is equally common in Africa and America.

Even in Europe there are nations amongst which abortion is permitted within certain limits. The Turks do not regard a fœtus as being really alive until after the fifth month, and have no scruple in causing its abortion. Even at later stages, when the operation becomes criminal, it is frequently practised. In 1872, at Constantinople, more than three thousand cases of abortion were brought before the Courts in a period of ten months. In such circumstances it is not surprising that illegitimate children are rare in the East.[1]

Artificial abortion is not a modern invention, but was common in ancient times. The old Greeks practised it openly, without any legal restraint. Plato regarded it as within the province of the midwife, and Aristotle permitted it to married people when a pregnancy that was not desired took place.

The natives of Kamchatka of the eighteenth century

[1] See Appendix VII.

married rather for sensual gratification than for procreation with which object in view they interfered with pregnancies by various kinds of medicaments and by violent operative measures.

The arts by which abortion has been produced are numerous and varied. In addition to the administration of drugs, implements have been employed. The natives of Greenland use the ribs of seals or of the walrus, and the Hawaians employ for the purpose a wooden implement fashioned as a deity.

On the other hand, certain races have strongly opposed the practice of abortion. In the ancient world such races were the Medes, the Bactrians, the Persians, and the Jews. Among the ancient Incas, abortion was a crime punished with death. Later on, the Christian nations followed this view. However, the reprobation of abortion occurs only in a comparatively small number of the nations of the earth, and even among these the practice is common in secret.

Animals, unable to procure abortion, very often destroy their young. In the human race, infanticide is common. The Greeks and Romans did not regard newly born infants as possessing a right to live. The old Germans exposed their infants. The Arabs, before the faith of Islam had spread to them, were in the habit of burying many female children alive. In India a similar custom is common, and in China it is notorious. The Chinese very often kill female children immediately after birth. About two-thirds of the number of female infants born are exposed as a general rule among the Hak-lo, and especially among the Hak-ka of the agricultural classes. In a little village in which the author lived for several years an investigation showed that women who had given birth to two children had killed at least one of them.

In Tahiti two-thirds of new-born children are killed, those of the female sex making up the greater part of the numbers. The first three infants and all twins are killed, and as a rule not more than two or at most three are actually reared. Among the Melanesians the custom of infanticide is very common.

It is not surprising that such a widespread occurrence of artificial abortion and of infanticide among primitive races is bringing about a rapid diminution in the numbers of these, and may lead to their extinction. This is taking place in the case of the natives of New South Wales, of New Guinea, and of the islands of Aaru. Nothing could show more plainly the feebleness of the human family instinct. In more highly civilized nations, the rude proceedings of savages have been replaced by clever devices to prevent conception, and infanticide has become rare. Artificial abortion is excited by modern methods suggested by the progress of science. The embryonic membranes are pierced not by the ribs of seals or hair-pins, but by sterilized instruments, and the operation is performed with strict asepsis. In averting the natural results of passion the woman is subjected to the smallest possible risk.

It is indubitable that more than one race has perished because of its lack of the instinct of family. However, it need not be feared that the human race itself will disappear because of the failure of procreation. But it is plain that the readiness with which devices to prevent the production of children have been adopted shows the weakness of the family instinct in man, and opens up a problem to which the attention of moralists and legislators may well be directed.

The family instinct is deeply seated, as it arose among animals more ancient than man; none the less it exhibits disturbances and aberrations in the human

race capable of bringing about the extinction of peoples or nations. It is, however, strong enough to secure that man will persist in the future.

Man certainly is a social animal, but the instinct impelling him towards union with his fellows is of recent origin. Such animal societies as are to be found among insects are not comparable with human associations. Among mammals, the nearest allies of man, the social instincts are developed only to a slight extent, and even the anthropoid apes show very little progress in this direction. Many of these creatures have shown in captivity the aptitude to become friendly with man or with other animals, and thus have displayed the beginnings of the capacity to form societies. But in the wild condition anthropoids live only in families, and these contain few individuals. As regards the social capacities of the chimpanzee Dr. Savage wrote :—[1]

"They cannot be called gregarious, seldom more than five, or ten at most, being found together. It has been said on good authority that they occasionally assemble in large numbers in gambols. My informant asserts that he saw once not less than fifty so engaged; hooting, screaming, and drumming with sticks on old logs, which is done in the latter case with equal facility by the four extremities."

We have little acquaintance with the social life of the anthropoids, but, so far as we know, these creatures present only the merest beginnings of the social instinct. Man has moved much beyond them in that direction. Even the lowest races and the most primitive of living peoples—such as, for instance, the Bushmen or the aborigines of Australia—display a well-developed social instinct.

The universal presence of the social instinct among human beings would seem to afford the basis of a happy life. In the numerous attempts made to find a purely

[1] Huxley, *Man's Place in Nature.*

rational principle that may serve as the basis for morality without the intervention of supernatural sanction, abundant use has been made of man's craving to live in association with his fellows.

Towards the end of last century Büchner published a materialistic code of morality that made a considerable sensation. He wrote :—

" What we term the moral sense arose from the social instincts and habits which, under pain of extinction, are developed in every society of men and animals. Morality depends on sociability, and varies with the peculiar conditions of each particular association. As man is essentially a social animal, and to be regarded, apart from society, merely as a wild beast, it is plain that the needs of the community must impose on him certain restrictions and directions that in time will pass into a settled code of morals."

Half a century later practically the same idea was repeated. Haeckel,[1] the well-known German naturalist, expressed it as follows :—

" Modern science shows that the feeling of duty does not rest on an illusory ' categorical imperative,' but on the solid ground of social instinct, as we find it in the case of all the social animals. It regards as the highest aim of all morality the re-establishment of a sound harmony between egoism and altruism, between self-love and the love of one's neighbour. . . . If a man desire to have the advantage of living in an organized community he has to consult not only his own fortune, but also that of the society and of the ' neighbours ' who form the society. He must realize that its prosperity is his own prosperity, and that it cannot suffer without his own injury. This fundamental law of society is so simple and so inevitable that one cannot understand how it can be contradicted in theory or in practice; and yet that is done to-day and has been done for thousands of years."

The sexual and family instincts may be satisfied in many different ways, and this is also the case with the social instinct. Onanism and perverted passion may satisfy the sexual instinct; celibacy, artificial abortion, and infanticide exist alongside the love of the wife and the parental cares. So also the social instinct of a

[1] *The Riddle of the Universe.*

criminal may be satisfied by his association with other criminals. It is well known that the most hardened criminals have their own codes, and they join faithfulness to their own companions to an atrocious attitude towards the rest of the world.

It is not enough then merely to give scope to the social instinct that we all possess. We have to determine how far, and towards which of our fellow-creatures, we are to exercise such instinct, and it is here that the difficulty arises which as yet has not been solved by either religion or rationalism. Must our social instinct reach to relatives near or distant, or to fellow-townsmen, or compatriots, or to all white men, or to all men, white and black, or to the good only, or to the good and bad alike? Should we limit the operation of the instinct to those of our own religion and to those who share our views of life? The instinctive feeling is quite silent on these points on which the difficulties arise. At different epochs and in different circumstances very different answers have been given to such questions. When religion was predominant, a common faith was a bond transcending patriotism; later on, patriotism itself became the dominant bond. At the present day a conception of international solidarity is beginning to appear. What is the bond that unites nations so different? It is not religion, for the bond includes Catholics and Protestants, orthodox Christians and Buddhists. Most probably the bond of union is a community of interest, the result of similar civilization and military and political organization.

It has been suggested that the social instinct, or human sympathy—for the terms are practically identical—may become so widespread that all the members of the human stock will unite and act only for the common good. But the problem is complex.

Sympathy, when pushed too far, may become harmful. Nations have taken part in a campaign, impelled by some feeling of sympathy, and have brought harm on themselves. Sympathy extended to criminals and wicked persons is equally harmful. The social instinct itself must be regulated for the good of the community which it holds together.

Ought we to extend our sympathy to all humanity, or to limit it to some particular section? Theorists have spoken of the solidarity of all humanity, believing it possible to extend our sympathy to the races furthest removed from us. In countries in which different races are brought in contact, very practical difficulties are encountered by the theorists. In America and in some other countries, for instance, laws have been passed against the Chinese, excluding the latter from the consideration granted to other races. The negro question also is very difficult in those countries in which the black race dwells among whites. In Europe it has been the custom to condemn the action of civilized races in taking their land from natives of primitive type. Sutherland, the author of a striking work on the origin and development of morality, justifies such arbitrary conduct. To the question, "Was it right for the whites to take possession of the Australian forests of the blacks?" he replied in the affirmative. "No doubt," he said, "there is a moral instinct against it, but the action undoubtedly was right." In a summary of his conclusions he lays down that moral conduct is a compromise between the individual and social instincts. But he has no more to say than his predecessors as to the rational basis of the compromise.

The social instinct has been acquired by mankind too recently and is still too feeble to be a trustworthy guide in all conduct. To obviate this difficulty divine sanction

has been evoked to control the relations among men. The categorical law has been formulated with the same object. Thus by one means or another, some kind of social order has been kept up.

In man the sexual and social instincts as well as the instinct for choosing food are still so weak that it is impossible to trust to them in the absence of other guidance. It is necessary to determine not only what kind of food is most suitable for men in different conditions of life, and what means are best fitted to satisfy their sexual and family instincts, but also to determine the direction and object of the social instinct.

If we love our fellow-creatures we should seek the best ways of making them happy. But what is happiness? Is it the feeling of well-being experienced by the individual himself, or is it the judgment of others on his sensations? It is notoriously difficult to pronounce on the happiness of another. From the outside, when a man seems to enjoy health, to have a family and comfortable means of subsistence, we are inclined to call him happy; but the individual himself may have a very different opinion. On the other hand, the opinion of an individual on his own condition may be equally fallacious. Very often the feeling of well-being is a symptom of general paralysis of the insane, a disease often attributable to syphilis, as may be inferred from the following words of Ballet and Blocq :—

" The patient is well pleased with himself, and delighted with his constitution and circumstances. He boasts without ceasing of his robust health, his muscular strength, the clearness of his complexion and of his general 'fitness.' His clothing is magnificent and his residence palatial. In a more advanced stage of the disease, the exaggeration becomes extreme. He believes that he is able to blow down the walls with his breath, or that he could carry a ton, or drink a hogshead of wine, or that nothing could tire him out. Then megalomania begins, and the patients believe themselves in possession of titles, of power, and wealth. They are members of parliament, noblemen, princes, generals, kings, emperors, and popes, or God Himself."

The social instinct is equally powerless to solve the problem of justice in its relation to the general interest of humanity. It is plain enough that, in the existing condition of human knowledge, we all inflict and undergo injustices of different degrees. This misfortune is a consequence of the disharmony of human nature.

From what I have already said, it must be clear that before we can find a rational guide to direct us in the operation of our social instinct, we should have to determine exactly the nature both of true happiness and of true justice for the individual.

CHAPTER VIII

DISHARMONIES IN THE INSTINCT OF SELF-PRESERVATION

It is not to be wondered at that man's social instinct exhibits so many imperfections and disharmonies, seeing that it is still in an unsettled condition, and is a recent acquisition. On the other hand, we should expect to find that love of life and the instinct of self-preservation had reached a high degree of harmony, since these have been in process of development throughout the whole animal series that culminated in man. Even in the lowest forms of life many contrivances exist for purposes of protection. Plants protect themselves, sometimes by means of thorns which prevent them from being eaten, sometimes by secretions either merely irritant in character or actually poisonous. The means employed by animals for self-preservation are even more numerous. Some of these, from mere specks of protoplasm (*foraminifera*) to giant clams big enough to trap a man by the leg, are protected by shells. Not only shells but also shields and carapaces, the secretion of fluids exhaling unpleasant odours, or facilitation of escape by clouding the water as in the case of the ink of the cuttlefish, offensive weapons, strong teeth, and many other characters, serve no other purpose than to protect the individual life.

Among lower animals the preservation of life is accomplished through non-conscious reflex mechanisms; later protective instincts begin to appear. Simple cases of these are flight at the approach of danger, or protection

by a covering of slimy froth secreted by the creatures themselves. Such facts show that the love of life and the instinct of self-preservation are almost universal in the living world.

All these devices for the avoidance of danger and escape from death could have been developed in animals before they had any distinct idea as to what death was. Some animals can distinguish between living and dead prey and some can recognize the smell of dead bodies. Those which are accustomed to feed on living creatures refuse all others, detecting the difference by the absence of movement. As in such cases the idea of death is imperfect, it is easy to deceive the creatures by offering carcases artificially set in motion, or living prey rendered motionless by some means or other. In order to escape from enemies so readily imposed upon, many insects when alarmed become motionless and feign death; and that may be regarded as yet another instance in the category of natural means for the protection of individual life.

Moreover, the higher animals, such as mammals, exhibit a profound ignorance of death, many of them remaining completely undisturbed in the presence of dead companions, or even devouring the latter at the risk of contracting a fatal disease. Rats, for instance, eat the bodies of rats which have died of plague, and while appeasing their hunger themselves contract the disease which they transmit to other animals, particularly to human beings. Unlike those animals, however, which are indifferent to the death of their kind, there are others that instinctively shrink at seeing the dead bodies of their own species. Horses on passing a dead horse show signs of uneasiness and attempt to run away. Bullocks when witnessing the slaughter of others also exhibit evidences of distress and fear. In spite of these

examples, however, it is quite certain that animals, even those highest in the scale of life, are unconscious of the inevitability of death, and of the ultimate fate of all living things. This knowledge is a human acquisition.

In full-grown man, the instinct of self-preservation is well developed. Hardly appreciable during infancy, it begins to manifest itself in young children. At the sight of a human corpse, children become panic-stricken, as though confronted by a wild beast or snake.

In young adults this instinct of self-preservation, which is closely connected with an instinctive fear of death, is not fully developed. It often takes some special circumstance to awaken it, such as a dangerous illness, an accident, or the perils of war. Young people, who while in good health believe their lives to be in danger, often take it to heart so as to make themselves really ill. In the normal course of life, however, the young do not show an instinctive clinging to life in any marked degree. They often risk their lives for trifling reasons, and commit all sorts of indiscretions hurtful to life or health without a thought of the consequences. They may be inspired by the highest motives, but they are equally ready to fritter strength away in the gratification of the lowest appetites. Youth is the age of disinterested sacrifice, but also of indulgence in all kinds of excesses, alcoholic, sexual, and others. Youths seem to think that they will always attach the same value to life, and that between death at thirty years of age and death at sixty there is a difference only of time. As their love of life is indifferently developed, young people are often extremely exacting, the pleasure they enjoy being but moderate, while the suffering provoked in them by the slightest annoyance is intense. They consequently become epicureans in the lowest sense of the

word, or else abandon themselves to exaggerated pessimism.

" Let us eat and drink for there is no joy after death " was the motto of German students, greedy for pleasure, and unknowing that a love of life develops with age in every human being. On the other hand, in order to keep the balance between joy and sorrow, youth, true to its instincts, undervalues the former and exaggerates the latter, thus arriving at a pessimistic view of life, and declaring that existence is a misfortune in itself. It is significant that Schopenhauer published his theory of pessimism at the age of thirty-one. His successor, R. Hartmann, when twenty-six years old, proclaimed that human existence is an evil which one should get rid of at all costs. Optimistic theories, on the other hand, have been set forth either by persons advanced in years or by persons whom special circumstances have caused to appreciate the joy of living. As a counterbalance to the pessimism of German philosophers, Duhring formulated a theory of optimism, though he was blind at the time. Sir John Lubbock in his *The Pleasures of Life* said : " Life is a great gift," showing that his own attitude towards life is entirely opposed to that of the pessimists.

It has long been recognized that the old attach a higher value to life than do the young. J. J. Rousseau, for instance, says : " Life becomes dearer to us as its joys pass away. The old cling to it more closely than the young."

One often hears people express their indifference to death, but an examination into their real feelings on the subject soon shows the true state of affairs. " He who pretends to face death without fear is a liar," said J. J. Rousseau.

Instinctive love of life, and fear of death, which is only

a manifestation of the former, are of an importance in the study of human nature impossible to over-estimate; it is therefore necessary to consider a few instances throwing light upon the subject. The subject is perhaps as well dealt with in a Buddhist legend as anywhere.

"The young Prince Sakya-Muni, the founder of the Buddhist faith, being desirous of discovering the true meaning of life, expressed a wish to leave the world and devote himself to a religious life. In order to turn him from his purpose, his father built him a magnificent palace, wherein he could indulge in every sort of pleasure, and in which he would be protected from all sorrow. Under this system he never saw old people, nor those who were diseased, nor the dead. In spite of being thus strictly guarded, the young prince often contrived to escape into the outer world in order to drive about. During his first drive, he met a broken-down, decrepit old man, with varicose veins, decayed teeth, a wrinkled skin, and grey hair, bent double with age like the roof of a house, leaning upon a stick; all traces of youth had departed from him, only inarticulate words came from his throat, his procumbent body resting on the stick, and his limbs and every part of them trembling."

Having learnt from his driver that this was an aged man, and that all living creatures must grow old, the prince was so deeply impressed that he said to his driver: "What a misfortune to be a weak foolish person, whose intelligence, blinded by the pride of youth, sees nothing of old age. Turn round my chariot; I would return. What are games and pleasures to me whose body is the future dwelling-place of old age?" Another time Sakya-Muni met on the road a man consumed by fever, his body weakened, his breathing difficult. Informed by his charioteer that the man was suffering from disease, the young prince exclaimed: "Health, then, is a mere dream, and the fear of disease takes a terrible form. What wise man, having seen such a phase of human existence, could continue to be gay and happy?" Shortly after Sakya-Muni went out for the third time, and "saw a dead man placed on a bier covered by a pall, surrounded by his relations, all weeping, lamenting,

wailing, their hair disordered, placing dust upon their heads, and beating their breasts." The violent emotion produced by the sight of the dead man caused the prince to say to himself: "Woe to youth threatened with old age! Woe to health, the prey of every kind of disease! Woe to the life of man which lasts but a little while! Woe to the attractions of pleasure which seduce the hearts of the wise." These reflections of Sakya-Muni are the basis upon which Buddhism is founded, and that religious philosophy is impregnated with pessimistic doctrines relating to human life.

Modern pessimists hold views resembling Buddhism. Schopenhauer from early youth was engrossed by the great problems of human life. At twenty-seven years of age he had revolted against the idea of death. The problem of death was one of those in which he was most deeply interested, and his terror of it was such that he left Berlin at the first outbreak of cholera in 1831 (influenced by the death of Hegel, who succumbed to the disease), and went to live at Frankfort, a town unvisited by the epidemic.

Zola's mother had died at Médan, and as the staircase proved too narrow the coffin had had to be lowered from a window; he declared that he never looked at that window without wondering who would be taken out that way next, he or his wife. "Yes," he said; "ever since that day death has always been in the background of our thoughts, and very often during the night, looking at my sleepless wife, I feel that like me she is thinking of it, and we lie quietly without saying aloud what is in our minds—for shame, yes, for very shame—*Oh! it is terrible, that thought—and the terror of it becomes visible!* There have been nights when I have leapt suddenly out of bed, and held myself for a second or two in a state of abject terror."

Shortly before he attained his fiftieth year, Tolstoi became bitterly tormented by the thought of death. He describes the beginning of this mental crisis in the following words :—

" First there came moments of perplexity, of arrest of vital force, as though I had lost the power of living and moving; I felt utterly lost, and fell into a state of complete dejection. This passed away, however, and I continued to live on as before. Before long the moments of perplexity became more frequent; the arrest of my living energies was always manifested by a renewal of the same questions, ' Why? and What comes after?' . . . The fact is that life is a blind alley. I had lived, worked, and marched onward, and had arrived at the edge of an abyss, and nothing remained to me but to fall into it. And yet I could neither stop nor retrace my footsteps, nor shut my eyes in order not to see suffering and inevitable death. It was a void, a complete annihilation. . . . In this condition I felt that I must cease to live, and, fearing death, I had to employ various ruses to prevent myself from taking my life. . . . I could attach no reasonable meaning to any action of my life. I was merely astonished to think I had failed to realize the position from the beginning. All that, I said to myself, must have been patent to all the world long ago. If not to-day, then to-morrow, disease and death—they are already here—will attack elderly persons—me—and there will remain only corruption and worms. My deeds, whatever they may be, will be forgotten sooner or later, and I shall be no more. Why then take pains about anything? How a man can know all this and yet go on living amazes me. One can only go on living just so long as one is intoxicated with life; once sober, however, one cannot fail to see what an idiotic fraud it all is. It is also true that there is nothing even amusing or intelligent about it; it is simply stupid and cruel and nothing more. . . . My family . . . I say to myself . . . but then my family, my wife, and children are also merely human beings! They live under the same conditions as I myself. They have the choice between living a lie or facing the horrible truth. Why then should they live at all? Why should I love, cherish, and protect them? In order that they may experience the same despair, or that they may go through life like idiots? Loving them I cannot conceal the truth from them; every step forward in knowledge leads to this truth; and the truth is death."

The idea that death is generally attended by pain is quite erroneous; it is, as Finot said, our ignorances and prejudices that are responsible for the creation of this superstition, so terrible to contemplate, so far removed from the truth. Instances which have occurred of people

threatened with death and suddenly restored to life, indicate that death, far from being painful, is attended by pleasant sensations. Heim, a Swiss savant, says that tourists who have had serious falls while mountaineering, and have been so near to death that they experienced all the premonitory symptoms, felt above all a sensation of ecstasy.

It cannot be denied that some forms of death are pleasant, but it is no less certain that in many other cases the sensation of approaching death is, on the contrary, extremely painful. This question, however, is not necessarily connected with the fear of death that may come to those who are not yet about to die. But it is precisely the latter mode of fear that is so important a factor in human life. Men who are dying of starvation do not feel painfully hungry at the moment of death. The actual pain of hunger lasts for only a limited period, after which it is succeeded by a condition of lassitude and general weakness, which, however, is different from painful hunger. The fear of death is similar, for in certain cases it does not last up to the end of life. The pain of thirst, on the other hand, is much more persistent, lasting up to the end.

Finot discussed the instinctiveness of the fear of death. "The question," he wrote, "is important. For if the fear be instinctive, it is independent of our will and not to be controlled by reason. It would then break out in every case at the approach of death. Now the evidence of many persons who have no more than escaped mortal danger is clearly against the view." Hunger is certainly instinctive, and yet is not always felt when the body is exhausted by want of food or menaced by death from starvation.

Closer investigation leaves no doubt but that the fear of death is truly an instinct. In some of the higher

animals it exhibits itself in the same fashion as other instincts. An intimate friend of mine was for years in constant expectation of death, and faced its approach with perfect calmness. Believing that he had played his part in life to the best of his power, not only did he think it quite natural that he should cease to live, but he regarded the possibility of a decrepit and painful old age with the greatest repugnance. In his case neither reason nor desire led to a fear of death. When, however, it was definitely diagnosed that he suffered from a disease which might prove fatal, there was aroused in him a certain sensation which must have been the fear of death. Tolstoi's sensations on reflecting that he would sooner or later cease to be, and that there would be left only corruption and worms, were no other than this instinctive fear of death, a fear that his reason was powerless to control. To follow Tolstoi in telling any one that the fear of death is a form of superstition which must be subdued by the intelligence, is no better than to attempt to console a woman about to undergo ovariotomy by telling her that as in future she will be unable to bear children she ought to subdue her sexual instincts. Her desire is not under control of her will but is a pure instinct.

The fear of death has long been recognized as an instinct. Schopenhauer himself interpreted it in this way. According to him, " from the point of view of intelligence there is no ground for fearing death. Reason, which is the outcome of knowledge, does not present death to us as an evil. It is certainly not the rational, conscious part of ourselves which fears death; the *fuga mortis* which pervades all living beings is an emanation of the blind will."

Lord Byron came to the conclusion that the fear of death is an instinctive manifestation. In *Cain* he expressed this view clearly :—

I live,
But live to die; and living, see nothing
To make death hateful, save an *innate clinging*,
A loathsome, and yet all *invincible*
Instinct of life, which I abhor, as I
Despise myself, yet cannot overcome—
And so I live.

Later on in the same poem Byron makes Cain say of his father Adam :—

Ere he plucked,
The knowledge, he was ignorant of death.
Alas, I scarcely now know what it is;
And yet I fear it, fear I know not what.

It is then indubitable that among the instincts of man there is one which loves life and fears death. This instinct develops slowly and progressively with age. In that respect it is astonishingly different from other instincts. When hunger or thirst or sexual desire is gratified a sensation of satisfaction is experienced, and this readily passes into satiety or even indifference. The mood lasts for a certain time, and then the instinctive needs reawaken. The instinct of life, however, behaves very differently. In most human beings it develops slowly and becomes stronger and stronger as the years pass by. In childhood and early youth we are very anxious to "grow up," but when we are adult we have no desire to grow old. We are greatly disturbed by the appearance of wrinkles and grey hair. Instead of being glad to have finished a great part of our mortal career, we feel sad at being nearer the inevitable end. Old age, as it usually presents itself, is marked by ugly features, and often by repugnant or even horrible characters. Little children are usually terrified by the appearance of very old persons, and it is a familiar nursery threat to send for an old man.

The murder of the aged is a custom widespread amongst the lower races. The natives of Fiji bury their old men

alive, on the pretext that they have become utterly useless. The custom is in existence throughout Melanesia, and occurs in New Caledonia and in most of the adjacent Polynesian islands. Old age is universally despised in that part of the world. The natives of Australia respect old people so long as they retain their activity, but once they become unable to take care of themselves they are abandoned. Often they are killed and eaten, and this custom is favoured by their religious beliefs. The ancient inhabitants of Germany killed old or sick people or often buried them alive.

The modern civilized world has certainly made considerable progress, for the old are no longer killed. However, in spite of the characters of old age which may make it horrible and useless, and in spite of the physical and intellectual weakness that accompany it, the instinctive love of life is preserved in the aged in its strongest form. I have visited almshouses for the aged, and it was easy to see that all the inmates hoped that their days might be prolonged. In a Home occupied by fairly well-educated persons, I discovered that one and all felt as if they were continually being threatened by death, as if they were convicts awaiting the day of execution. At the Salpêtrière, where there are a number of very old women, septuagenarians are regarded almost as young girls. The great ambition of women of eighty is to live to one hundred, and the desire to live is almost universal.

This seems a contradiction of another fact demonstrated by statistics—that age increases the frequency of suicide. It is certain that more old men commit suicide than young men, but, on careful inquiry into the statistics of the subject, it becomes evident that the chief incentive to suicide does not lie in the cessation of the will to live, but in the difficulties experienced by

old people of earning a living, and in the frequent presence of disease in the aged.[1] Deprived of the means of existence, refused the shelter of charitable institutions, old men are apt to fall back upon a rope or the fumes of charcoal. Statistics relating to the suicide of the aged show that the greatest number of victims belong to the poorer classes. The suicide of rich old men is generally prompted by the presence of incurable disease.

The instinctive love of life resembles the sexual instinct in a great many women. Just as the love of life goes on increasing when the best of life is past, sexual pleasure is often unfelt by women until their beauty is already faded. Another character common to the love of life and the sexual instinct is that they both persist throughout old age, although they can no longer be satisfied.

Edmond de Goncourt relates in his diary that at his reunions of literary celebrities (Zola, Daudet, and Tourgéneff), the conversation turned most frequently upon the subjects of love, life, and women. "Death or love, strangely enough," says Edmond de Goncourt, "are always what we talk about after dinner." Old age was even then knocking at the doors of the distinguished writers mentioned, and so it is quite natural that their interest should have been wholly absorbed by the two instincts which exhibit such enigmatic and paradoxical tenacity.

The disharmony of the instinctive love of life which manifests itself when death is felt to be near at hand is incomprehensible and terrible, and humanity, from time immemorial, has sought the key to the tragic puzzle, and tried by all the means in its power to unravel the mystery. The religions of all times have been concerned with the problem. "Religion," says Guyau, "consists for the

[1] See Appendix VIII.

most part of meditation upon death. If we had not to die there would probably be still more superstitions among men, but there would probably be no systematized superstitions nor religions." Philosophy also has tried to solve the question of death. Some ancient philosophers held the opinion that philosophy is only a meditation upon death. Socrates and Cicero have well said that " the life of a philosopher is a continual meditation upon death." Schopenhauer developed the same theory. " Death," he said, " is the real inspiring genius of philosophy. . . . Without death it is doubtful if philosophy would exist at all."

Judging from the facts already set forth there can be no doubt but that the human constitution, although in many ways perfect and sublime, exhibits numerous and serious disharmonies, which are the source of all our troubles. Not being so well adapted to the conditions of life as orchids are, for example, in the matter of their fertilization by the mediation of insects, or the burrowing wasps for the protection of their young, humanity resembles rather those insects the instinct of which guides them towards the flame which burns their wings.

CHAPTER IX

RELIGIOUS ATTEMPTS TO COMBAT THE ILLS ARISING FROM THE DISHARMONIES OF THE HUMAN CONSTITUTION

THE will to live, to preserve health, to satisfy the instincts and to make them act harmoniously, has driven mankind, from the very earliest days, to seek remedies for the imperfection of the human constitution.

Even in the case of lower animals the instinct as to choice of food does not save them from certain harmful substances. Man himself has long recognized that this instinct of his is no safe guide, and has tried to discover surer methods of distinguishing between substances that are useful as foods and substances that may cause disease or death. The best wisdom of primitive man must have been devoted to observing the effects of substances which had been eaten, and to a consequent framing of dietary rules.

The reproductive functions likewise attracted the notice of man in very early times, as he must have been struck by the harm ensuing from a blind following of instinctive desire.

His instinctive love of life and fear of death impelled man to seek wise choice of food and control of sexuality.

Since the dawn of intelligence man has tried to judge the unknown from the analogies given by what he knows best—his own self. Thus he came to attribute to everything around him qualities like his own qualities and motives like his own motives. He came to think, not only that all living beings were possessed of will and intelligence, but also that inanimate things conducted themselves like human beings.

Such a primitive idea is the basis of animism, the foundation of the philosophy and religion of savage and civilized man alike. When a man was seen to die, it was plain that he did not entirely disappear, but merely became transformed into a new condition. The dead body was thought to be alive in a fashion of its own. This was the answer to the desire for the preservation of life, to the fear of death—that is to say, of total extinction. It is practically identical with faith in immortality and a future life.

The animistic conception is almost world-wide. It is plain that it afforded the most efficacious palliative for minds revolting against the inevitability of death, and that it harmonized with our intense will to live.

"Such child-like ignoring of death, such child-like make-believe, that the dead can still do as heretofore, may well have led the savage to bury with his kinsman the weapons, clothes, and ornaments that he used in life, to try to feed the corpse, to put a cigar in the mouth of the skull before its final burial, to lay playthings in the infant's grave. But one thought beyond would carry this dim blind fancy into the range of logical reasoning. Granted that the man is dead, and his soul gone out of him, then the way to provide that departed soul with food or clothes or weapons is to bury or burn them with the body." [1]

The Turanians of Eastern Asia bury with their dead all sorts of implements, such as axes and flints, and food, such as meat and butter, believing that the departed will have need of these during the long voyage in the land of the spirits. A Tasmanian, on being asked why spears were buried with the dead, replied, as if the answer were self-evident, "Of course for the use in combat of him who has fallen asleep." The Greenlanders place bows and other weapons in the tombs of their men, and knives, needles, and other instruments for sewing are buried with their women, in the full belief that such objects will be useful in the other world. In

[1] Tylor, *Primitive Culture.*

the Congo region, the curious custom exists of leaving a hole in the grave over the mouth of the dead body, and once a month passing into this hole meat and drink.

Many races are not content to place merely inanimate objects in the graves. The Caribbeans, believing that the human spirit after death is carried to the kingdom of dead souls, sacrifice slaves on the tombs of their chiefs in order that the latter may be attended in the next world. With the same object they bury dogs and weapons. The negroes of the Gold Coast, at the funeral of a great man, kill women and slaves; they bury with him his finest apparel, his fetishes, corals, and pearls, so that he may be provided for in the next world.

According to Herbert Spencer there is abundant evidence that all, or nearly all, societies and nations have a belief, vague or clear, in the resurrection of a double of the dead man. It has been suggested that the origin of this widespread belief is the image of the departed that comes to us in dreams, which is taken as a real visit of the dead.

In civilized races there are numerous relics of the old beliefs. The Spaniards set bread and wine on the graves of their relatives on the anniversaries of their deaths. The Bulgarians hold a feast of the dead on Palm Sunday, and leave the remains of the banquet on the graves of their relatives that these may consume them in the night. Although the sacrifice of men and animals is no longer made by civilized peoples at burials, many funeral customs have an obviously animistic origin.

The belief in life after death, so widespread in the world, has been the foundation of all religions. Among races that have inhabited very different parts of the earth, that have had very different manners and have passed through different stages of civilization, the conviction has been strong that death is not the end of

all, but only a door leading from one kind of existence to another.

Haeckel has repeated a common opinion that belief in the immortality of the soul was absent from the oldest and purest form of the Jewish religion. "There is not to be found," he said, "either in the Pentateuch or in those more ancient parts of the Old Testament which were written before the Babylonian captivity, any idea of the persistence of the human soul." This is true only within limits. No doubt the books of Moses contain no reference to a future life nor to heaven and hell in the sense of modern creeds, but it is no less true that the ancient Jews shared with other races the conception of a survival after death.

"Like almost all primitive nations," wrote Renan, "the Hebrews believed in a kind of double personality, in a shadow pale and thin which, after death, descended underground and passed a sad and colourless existence in the sombre halls of the dead. The dead dwelt there, without feeling, or knowledge, or memory, in a world without light, abandoned by God. At the most the old Hebrews hoped to obtain for themselves a quiet resting-place, a pleasant couch for the time when they would be with the dead. It comforted them to picture themselves as lying amongst their ancestors in quiet communion."

Ancestor worship, which is associated closely with the idea of a future life, appears repeatedly in the Pentateuch. Jacob, when he felt death coming upon him, called his son Joseph and said unto him: "Bury me not, I pray thee, in Egypt; but I will lie with my fathers, and thou shalt carry me out of Egypt, and bury me in their burying-place." The children of Israel, and in fact all other peoples, were strongly tinged with animism and ancestor worship.

It is very remarkable how the idea of a future life, which was vague in the early days of Israel, grew more and more clear. Ezekiel when he had "seen the visions of God," prophesied of things to come, and declared

that God would breathe life into the dry bones of the dead. The Book of Daniel (xii. 2) expressed the same idea in stronger fashion: "And many of them that sleep in the dust of the earth shall awake, some to everlasting life and some to shame and everlasting contempt."

"It is plain," said Renan, "that Israel had now reached the last stage in the secular development of her ideas, and had reached the conception of the kingdom of God as synonymous with the future world and the resurrection. As the conception of a soul distinct from the body was foreign to her, she could not conceive of a future life apart from resurrection of the body."

Still later, in the Talmud, paradise is depicted as a region filled with sweet odours, while hell is an unclean place, thick with mire and smoke; in the life beyond the grave, "there is neither eating nor drinking; the good sit there with crowns on their heads and see God in bliss."

At the date of the Cabalistic philosophy, the Jews had embraced the doctrine of transmigration of souls, and had come to believe that the spirit of Adam had entered David and would pass on to the Messiah. Some human souls passed into the bodies of animals, into the leaves of trees, or even into stones. It is plain that the idea of a future life was a part of the Jewish religion.

It has been said, also, that the idea of a future life was absent from the religions of the Chinese. Büchner,[1] for instance, who came to be almost the official representative of the materialism of the second half of last century, asserts that "Buddhism, that famous religion, the most widespread and one of the most ancient, which counts among its followers nearly a third of the inhabitants of the earth, ignores completely the immortality of the soul." Haeckel, also, in *The Riddle of the Universe*, a volume that sums up the materialism of the end of the

[1] *Force and Matter.*

last century, makes a similar statement. "The higher oriental religions include no belief whatever in the immortality of the soul; it is not found in Buddhism, the religion that dominates thirty per cent. of the entire human race; it is not found in the ancient popular religion of the Chinese, nor in the reformed religion of Confucius which succeeded it."

This question demands a somewhat closer investigation. It has been proved that the basis of the ancient religion of the Chinese was no more than an extreme development of ancestor-worship. Every important event in family affairs was accomplished "in the presence of the ancestors." It was a bond with relatives beyond the grave. As in other cases of animism and ancestor-worship, meats were offered to the dead, and objects were buried with them to be of service to them. That the Chinese believed in personal survival is proved by their custom of offering real food, clothing, and precious things to dead persons.

As the idea of immortality became developed further, the Chinese modified their customs. Instead of offering to the dead material objects, as is still done by many peoples, they came to substitute emblems. "Houses and clothing and food imitated in paper, and dolls of paper and straw to represent slaves, are burned, so that the spiritual forms of these objects may be offered to the spirit they wish to honour." [1]

One of the chief motives of ancestor-worship is fear lest the dead, if neglected, may visit their wrath on the living by sending plagues and pestilence upon them.

The worship of the dead had laid hold of the Chinese so firmly that even Confucius, notwithstanding his intelligence and scepticism, paid it a large tribute. "Confucius

[1] A. Réville, *History of Religions*.

the philosopher," said Réville, " regarded it as a duty to offer to his ancestors the gifts of food that princes had sent to him desiring to honour him."

Confucius and his followers were reticent and ambiguous in their references to a future life, but that did not prevent them from " observing the customs and ceremonies as carefully as if they had had a confident faith in the immortality of the soul." [1] Although Lao-tse himself believed neither in heaven nor hell, and professed the most rationalistic views, his disciples none the less accepted the doctrine of immortality, and even came to believe in rewards and punishments after death.

The followers of Lao-tse, the Taoists, devoted themselves specially to the problem of immortality and even tried to discover an elixir that would prolong earthly life to eternity.

" One of the chief claims of Taoism was the possession of a specific against death. It was true that they admitted this to be not only very difficult to obtain, but still more difficult to employ. However, if certain rules were observed strictly they were at least confident of great prolongation of life. It was only the very few Taoists who had reached perfection who could hope to pass into the better world without being subjected to the pains of death." [1]

And so some of the masters of Taoism—such, for instance, as Chang-Tao-Ling—ascended to heaven without dying, by climbing a lofty peak and vanishing into the skies.

The ordinary Taoists accepted fully the idea of immortality. They " taught the doctrine of purgatory for those who were not evil. To arrive at this, Lao-tse simply expanded and applied to mankind generally an idea that was already familiar to him, the conception of the transmigration of one soul through several successive bodies. By means of such expiatory transformations,

[1] A. Réville, *loc. cit.*

a man who had not reached it directly through the holiness of his life, could attain the immortality of genii and the blessed.'' [1]

It was believed for long that the Taoists, following the teaching of their master, did not recognize a hell. But this opinion has had to be abandoned, because the '' Taoist clergy have provided, in the temples dedicated to the tutelary deities of their cities, paintings illustrating the torments prepared for the guilty by the ten courts of justice that sit in the depths of an ocean hidden in the interior of the earth.'' [1]

Clearly then, many Chinese, both Taoists and followers of Confucius, believe in the existence of a world beyond the grave. However, the denial of immortality has been ascribed to Buddhists in particular.

Buddha accepted the Brahmanist doctrine of transmigration of the soul. This has been established clearly on the evidence of several documents of admitted authenticity. Orthodox Buddhism is somewhat vague on the immortality of the soul. Buddha himself avoided making a decisive statement on this matter. In such circumstances '' those who were terrified at annihilation, and who could not give up the hope of eternal happiness, interpreted the silence of Buddha according to their own desire, and inferred that he did not forbid them to hope.'' [2]

There are many instances of the evasions of Buddhist teachers when they were pressed with this disturbing question. Pasénadi, the king, once met Khémâ, the nun, a disciple of Buddha, renowned for her wisdom. The king put to her the following question : '' Does the Perfect One (Buddha) exist after death ? '' '' The Sublime One, O great king, has not revealed to us the

[1] A. Réville, *loc. cit.*
[2] Oldenburg, *The Buddha.*

existence of paradise beyond the grave." "Then the Perfect One exists no longer now that he is dead, O reverend lady?" "Neither, O king, has the Sublime One revealed that He who is perfect does not exist now that He is dead." "Am I to believe, then, O reverend lady, that the Perfect One still lives, although He is dead, and at the same time does not live? Am I to believe, O wise lady, that the Perfect One, being dead, neither exists nor does not exist?" [1]

The Buddhists, as they were not given clear doctrines on this subject, very naturally followed their inclinations by accepting the idea of life beyond the grave. And certainly Buddhism does not teach annihilation of the body after death, although this has been lightly taken for granted. On the contrary, it so assumes survival after death as being the rule that it grants only to rare and elect souls the privilege of at length laying down the burden of continuous life.

The Chinese Buddhists retained the fundamental conceptions of the ancient religion of their land and continued to worship their ancestors and to seek the readiest path to immortality. They soon came to transform Nirvâna into paradise, and to inculcate the doctrine of future rewards and punishments.

"The Buddhist monasteries in China for the most part possessed a set of little rooms, in which there were depicted, in vivid colours, crowded scenes from the eighteen hells of tribulation and lamentation. For there exist under the earth eight hells filled with the torments of fire, and ten with the equally terrible horrors of ice." [2]

The paradise of the Chinese Buddhists, or Ni-pan (Land of the Pure), is a region abounding in

"gold and silver and precious stones. Rivers of crystal run on golden sands covered with splendid lotus-flowers and traversed

[1] Oldenburg, *The Buddha.* [2] A. Réville, *loc. cit.*

by delightful paths. Lovely music is always to be heard. Three times a day a shower of blossoms falls. There are to be seen there gorgeous birds, pheasants, and parrots, and many others; and these, every quarter of an hour, in a choir of melodious voices, trill out the beauties of religion and recall to their hearers the Buddha, Dharma, and Sungha. These are some of the wonders prepared for those who are born again after death. Into that land neither sin nor any evil enters." [1]

The vast majority of mankind is convinced that death puts no definite term to existence, and that this life is no more than a passing stage leading to a life to come. However, although many simple races believe that the future life is merely a continuation of this one, the more subtle-minded races present the future life as filled with delights for the good and with torments for the wicked.

Such an idea of the next world, which is very generally accepted, is probably the basis of religions. From it have come the conceptions of supreme beings and divinities. Many facts go to show that the primitive gods were no other than the ancestors of the living, now abiding in another world and ruling the affairs of this one. Wicked ancestors became transformed into evil deities, while good ancestors became mild and benevolent ones.

Many peoples offer prayers to their ancestors and treat them as gods. The Kaffirs pray and sacrifice to their dead relatives, believing that the spirits of the dead haunt their late dwelling-places, and, according to their characters, help or torment their descendants. As they are able to cause good or evil after death, these play the part of gods. But it must be remembered that the god of a savage is only a being like unto himself, although probably rather more powerful.

The North American Indians pray to the spirits of their forefathers for good weather or luck in hunting, and

[1] A. Réville, *loc. cit.*

fancy when an Indian falls into the fire that the ancestral spirits pushed him in to punish neglect of the customary gifts, while the natives of Louisiana build temples for dead men. In Polynesia " at Tanna, the gods are spirits of departed ancestors ; aged chiefs becoming deities after death, presiding over the growth of yams and fruit-trees, and receiving from the islanders prayers and offerings of first fruits." [1] In the Malay Islands " the souls of deceased ancestors are looked to for prosperity in life and help in distress." In Africa ancestor-worship is well developed. The Zulu warriors,

" aided by the ' amatongo,' the spirits of their ancestors, conquer in the battle. Even the little children and old women, of small account in life, become at death spirits having much power, the infants for kindness, the crones for malice. But it is especially the head of each family who receives the worship of his kin."

The Zulu adores his father, when he is a chief, above all others, and is convinced that a father, remembering his love for his children, will not forget them when he is dead. " The Zulu follows up the doctrine of divine ancestors till he reaches a first ancestor of man and creator of the world, the primeval Unkulunkulu."

The fundamental idea is always identical, although details and accessories vary, as one passes from the almost idolized relatives of negro tribes to the " Father Almighty, Maker of heaven and earth," of the Nicene Creed. The conception of a future life in some kind of immortality, associated with the conception of many gods or of one God, has been developed to satisfy the craving for life and to combat the fear of death.

Many primitive races have absolute faith in the tenets of their religion, and firmly believe in the promise of life beyond the grave. The aborigines of the Fiji islands are convinced that they will be born again, in another

[1] Tylor, *Primitive Culture*.

world, in the exact condition in which they leave this one; and so they wish to die before being afflicted with any infirmity. As it is very difficult to reach old age without being the victim of some illness or infirmity, when a man feels the approach of age, he tells his children that the time has come for him to die. If he himself fails to give this notice, the children undertake the duty. A family council is called, the day is appointed, and the grave made ready. The old man is allowed to choose between being strangled and being buried alive. Hunt, an English traveller, quoted by Lubbock, received a visit from a young native of Fiji whose purpose was to give an invitation to the funeral of his mother which was to take place next day. Mr. Hunt accepted the invitation and joined the procession, but as he was surprised to see no dead body inquired about it from the son. The son pointed out his mother, walking in the procession and as gay and animated as any of the others. Mr. Hunt stated his surprise, and asked why he had been deceived by being told that the mother was dead, when she was plainly as much alive and well as any one else. He received the reply that the death festival was about to be celebrated; that presently they would bury her; that she was old, and that his brother and he, thinking that she had lived long enough and should be put to death, had obtained her cheerful consent. Many villages have been described as containing no inhabitants of a greater age than forty years, all those older having been buried. It is not difficult to understand that death should have no terrors for persons possessed of a faith as strong as this.

I know a case of a young girl of the Catholic faith who believed so firmly in the joys of paradise that, when stricken with a mortal illness, she awaited death with a great impatience. Before she died, she cried out that

" already she could see the beautiful flowers and hear the sweet music of the birds that fill heaven."

It is only with fanatics and primitive persons that blind faith can subdue this instinctive fear of death. For this reason, since the most ancient times religions have sought out something more than the promise of paradise to mitigate this chief disharmony of our nature. In this connection the doctrines of Buddha are most interesting. Here I shall not deal with that modified and transformed Buddhism in which there was a return to the doctrine of future life, with its hell of torments and heaven of delights. Buddha's doctrine, in its original form, was extremely pessimistic.

" Miserable in truth is this world, in which there is beginning, birth, growing old, death, disappearance, and renewal. But we know not how to escape from this world, full of horror though it be. Alas, because of old age, illness, death, and their like, we know not who shall put an end to this world, which is so full of horror. To all who are, there comes old age, and illness, and death, and their like. . . . Woe upon youth, threatened by old age ! Woe upon health, which so many maladies destroy ! Woe upon the life of man, which lasts but a little space ! Woe on the temptations of the flesh, which lure the heart of the wise ! Would that there were neither old age nor illness, nor death and the pains of death, which come from the five elements of life (Skandhas) ! Would that there were neither old age nor illness nor death, which are for ever bound up together ! Nevertheless, when I return again I shall consider deliverance."

In his famous " Sermon at Benares," Buddha gave in brief the outlines of his doctrines in the following words :—

" Hear, oh monks ! the holy truth of the springs of sorrow ! Sorrow is born of lust of life, that drags us from incarnation to incarnation, and of pleasure and desire, which seek their fulfilment hither and thither; the lust of pleasure, the lust of life, the lust of power. Hear, oh monks ! the holy truth of the conquest of sorrow; it is the killing of this lust by the utter abandonment of desire, the giving up of all desire, the forgetting of all desire, the freeing of the body of all desire, until there is no place left for desire."

In such a spirit of resignation, Buddha himself became a monk, and lived according to the strict rules of the pure life that he himself had laid down (" the belief pure, the will pure, the language pure, the deeds pure, the means of livelihood pure, the study pure, the attention pure, the meditation pure "). However, he did not find many kindred souls to follow the same precepts, and Buddhism soon moved away from these original tenets, and became a religious doctrine.

We are inclined to associate with Buddhism the cult of Nirvâna, as if the latter were the goal to which human life should be directed. Many philosophers, and the pessimists chief among them with Schopenhauer at their head, have adopted Nirvâna as the goal of mankind.

Rhys Davids thinks that Nirvâna is to be interpreted as a tranquillity of the soul, possible of achievement in this life, and that the word is best translated by the term " sanctity." According to him, Nirvâna does not mean annihilation, but rather freedom from the great passions. Dahlmann tries to prove that Nirvâna in its primitive signification implied the abolition of the will to live, and does really correspond to annihilation.

The later Buddhism adopted the Brahmanistic doctrine of transmigration of souls. Before his birth as a prince the Buddha is said to have passed hundreds of earlier existences. His soul had been the soul not only of fifty-eight kings, but of eighteen monkeys, four horses, four snakes, three lizards, two fish, and other creatures. Such continual transferences of the soul to so many different animals were a source of perplexity and sorrow to believers. It was natural that a great thinker like Buddha should have conceived the desire of sparing himself and his faithful followers so many transmigrations. He thought of these rebirths as a great evil, from which a pure life might set one free.

In the poetical language of the Hindoo Buddhists, metempsychosis was compared to the ocean; the waves that change from moment to moment were the continual rebirths; our temporary body was the foam of the crests of the waves, while Nirvâna was the opposite shore. He who reaches Nirvâna would never again plunge into the great sea of Sangsâra.

To avoid being tormented after death by perpetual rebirths, some of which may be humiliating, it is necessary to live a pure life and so to secure repose or Nirvâna. Nirvâna is by no means the cessation of all consciousness, but merely the end of transmigrations. From such a point of view it is possible to interpret all, or at least nearly all, the passages in which Nirvâna is spoken of.

When he was old and full of disease and afflicted with grievous pain, Buddha, being at the point of death, thought of his disciples and called them to him and said: "It is not meet that I should enter Nirvâna without having spoken with those who have cared for me, without speaking to the community of disciples. By the force of my will I shall subdue this disease and hold the life within me." Growing more and more feeble, the spirit of Buddha passed from ecstacy to ecstacy, knew every delight and then entered into Nirvâna; the earth trembled, and thunder rolled across the skies.

It is clear, then, that Nirvâna was associated with death. But it was with the death of a saint who had lived a pure life. Metempsychosis would not be inflicted on him, and he would enjoy repose. It is probable that the term Nirvâna later on came to be applied to the state of mind of a saint who, by living the pure life, would avoid transmigration after death.

Buddha's attempt to remedy the ills of human life lay in a complete renunciation of all the joys and

pleasures of life, and in perfect resignation. The mere fact that primitive Buddhism did not persist, but rapidly passed into an ordinary religion, is sufficient proof that Buddha did not achieve his purpose. It was the promise of a life to come that attracted so many men and spread Buddhism over so large a part of the earth. However, this faith has been able to maintain itself only in certain strata of society to which the rationalistic conception of the mental processes has not penetrated. Since the awakening of the scientific spirit in Europe, it has been recognized that the promise of a future life has no basis of fact to support it. The modern study of the functions of the mind has shown beyond all question that these are dependent on the functions of the body, in particular of those of the central nervous system. A slight lowering of the rate of the circulation of the blood, a fleeting anæmia of the brain, at once arrests consciousness. Anæsthetics, used in doses so small that they do not influence certain parts of the nervous system, as, for instance, those that control the heart and lungs, completely abolish consciousness. Persons who are put under chloroform fall into a state of absolute unconsciousness. Sometimes, after undergoing painful sensations, especially sensations of oppression, the patients imagine themselves to be in rapid motion, and in a few moments have the sensation of falling, after which comes the annihilation of sensations and of consciousness. Such states are very closely similar to death.

Neither the narcosis produced by chloroform nor that produced by any other form of anæsthetic affords any particle of ground for the view that there is consciousness in any form apart from the brain. The action of morphine sometimes brings about a strange feeling of happiness and weightlessness of the body; but here

again there is no suspicion given as to the existence of any mental phenomena apart from the brain.

Consciousness of personality is of supreme interest from the point of view of personal immortality, and this mental phenomenon develops only slowly and progressively in an infant. This fact, again, like the facts of narcosis, shows the dependence of consciousness on the action of the bodily organs. Just as our consciousness comes out of nothing in the first months or years of our life, so it will pass into nothing at the end of our life.

Mental disease confirms this conclusion, and it, too, gives no ground for the belief in a survival of the mind after death.

Certain internal sensibilities in the depths of our organism survive our personal consciousness. When the heart has ceased to beat and the bloodless brain is incapable of consciousness, some portions of the body may still retain vitality. Muscle fibres are still able to contract when stimulated, and the white corpuscles of the blood can still move about. It is certain, moreover, that these white corpuscles possess a specific sensibility, and, by a sort of sense of taste, respond to the kind of environment that surrounds them. Our consciousness, however, is absolutely out of touch with the sensations of these tiny blood cells, which none the less are part of our organism. It happens that in certain diseases these white corpuscles, stimulated by the presence of particular substances, perform extensive movements of migration within our bodies. Such migration, again, is quite outside the sphere of consciousness. The corpuscles, directed by their sensibility, are in constant pursuit of microbes that have entered the body, and yet these actions, too, are not made known to our consciousness. In the same way the active

spermatozoa in the male organs and the ova in the female possess specific sensibility. These reproductive elements contain the germ of individual consciousness, but it is not until they have developed into the new generation that it is possible to impute to them individual consciousness, and the organism that shelters them has no idea of what it harbours. The sensibility of the white corpuscles and of the many other cells composing our body has no part in the absolutely special sensation that we call individual consciousness, and which is all we think of in wishing to escape death.

The idea of a future life is supported by not a single fact, while there is much evidence against it. The phenomenon of intercommunication across a distance, sometimes called telepathy, may be actual, but affords no support to the conception of the existence of souls apart from bodies. It may be that emanations are given off by certain organs, and that these are capable of being appreciated by the organs of another body at a distance; but, even if such were the case, we should have to deal simply with other bodily functions. Moreover, the supposed phenomena that fall within this category are so rare, so difficult to observe, and so obscure, that no certain argument for the continuance of existence after death can be deduced from them.

It is easy to see why the advance of knowledge has diminished the number of believers in the persistence of consciousness after death, and that complete annihilation at death is the conception accepted by the vast majority of enlightened persons.

Apart from their chief function of consoling men for the inevitability of death, religions have concerned themselves with some of the results of other disharmonies of the human constitution. From time immemorial they have claimed the direction of diet, the control of

the reproductive functions, and the prevention or cure of all kinds of disease.

The dietary regulations given by religions are familiar. Even at the present day, the cookery of many races is regulated by their religion. The Jewish diet, notably, is regulated by the Mosaic law, down to the most minute detail. Moses commanded :—

"Notwithstanding, thou mayest kill and eat flesh in all thy gates, whatsoever thy soul lusteth after, according to the blessing of the Lord thy God, which he hath given thee; the unclean and the clean may eat thereof, as of the roebuck, and as of the hart. Only ye shall not eat the blood; ye shall pour it on the earth as water. . . . Only be sure that thou eat not the blood; for the blood is the life; and thou mayest not eat the life with the flesh. . . . Thou shalt not eat it, that it may go well with thee, and with thy children after thee, when thou shalt do that which is right in the sight of the Lord. . . . Eat not of it (flesh) raw, nor sodden at all with water, but roast with fire, his head with his legs, and with the purtenance thereof." [1]

It has been suggested that these rules were founded on ideas of hygiene in consonance with the results of modern science. Some of them, it is true, such as the prohibition of uncooked or partially cooked meat, are confirmed by modern knowledge. But the greater number of the Mosaic rules, as, for instance, the prohibition of the consumption as food of blood or the flesh of pigs or hares and so forth, are in direct opposition to modern knowledge of hygienic diet. Religious cookery has no more than a historical interest.

Religions have been greatly occupied with the functions of the reproductive organs. Most of the founders of the great faiths have paid a keen attention to the disharmonies of this side of our constitution. They became persuaded of the merit of abstention, which they practised themselves and preached to others.

[1] Deuteronomy xii. 15, 16. Exodus xii. 9.

Buddha, after devoting his youth to all the pleasures and not being satisfied, passed to absolute asceticism. He and his adepts formed an order of monkhood, on which strict celibacy was imposed. If a member of the order had intercourse with a woman, he was considered to be as guilty as a murderer. In the Buddhist rules framed for laymen, sexual intercourse outside marriage was forbidden as being degrading.

The views of the Christian religion on sexual matters are well known. The leaders of Christianity abstained from sexual intercourse and recommended their conduct to others. St. Paul more than once affirmed his own continence.

"For I would that all men were even as I myself; but every man hath his proper gift of God, one after this manner, and another after that. I say therefore, to the unmarried and widows, It is good for them if they abide even as I; but if they cannot contain, let them marry, for it is better to marry than to burn." [1]

The religions of savage races are equally concerned with the reproductive functions. There are many extremely strange facts known concerning this matter, and among such I may mention that the Sandwich Islanders have a deity who presides at abortions. This god is made in the form of an elongated wooden instrument, and is known as "Kapo." The upper part of the deity is shaped into a grotesque head, while the lower portion terminates in a point and serves to induce abortion by entering the uterus and rupturing the fœtal membranes.

Many other idols are used by savages as protections against disease. The ruling idea in the manufacture of these is that diseases are due to the presence of evil spirits, who are to be scared away as soon as possible. The Goldi of Siberia construct straw or wooden figures of men and animals to absorb the spirits of diseases.

[1] Corinthians vii. 7–9.

The Guilaks make wooden human figures, on the breasts of which are fashioned images of toads. These talismen are used as remedies for diseases of the chest and stomach.

In higher forms of religion there remain abundant traces of such notions. Even Luther declared : " Behold a matter on which there is no room for doubt, and that is that the plague, fevers, and other diseases are the work of the devil." A number of religious ceremonies were specified as the best remedies for diseases.

Plague has left many deep marks on human history, and it is natural that a malady so terrible should have attracted serious attention. It was usually attributed to divine wrath, which was to be appeased by purification and sacrifice. Human beings were slain on altars to appease the wrath of God and to lessen the mortality from plague.

Such religious customs have disappeared almost completely with the advancing culture of man, but traces of them survive and become apparent on occasions. When King Edward VII was seriously ill he was given the assistance of the most highly skilled modern surgery, but at the same time special services were held in the churches to aid the cure of the royal invalid.[1]

Every one has now come to regard such events as mere relics of old customs without intrinsic importance. Hygiene in the kitchen and the prevention of disease are no longer under the control of religion, but are regulated on scientific knowledge obtained by the experimental method. However, religion is still occupied with the problem of death. The solutions which as yet it has offered cannot be regarded as satisfactory. A

[1] Fresh in the reader's memory will probably be the special prayers for rain offered up in many churches during recent droughts.—C. M. B.

future life has no single argument to support it, and the non-existence of life after death is in consonance with the whole range of human knowledge. On the other hand, resignation as preached by Buddha will fail to satisfy humanity, which has a longing for life, and is overcome by the thought of the inevitability of death.

CHAPTER X

ATTEMPTS IN PHILOSOPHY TO REMEDY THE ILLS ARISING FROM THE DISHARMONIES OF THE HUMAN CONSTITUTION

Systems of philosophy are closely attached to religious doctrine. Buddhism, for instance, originated in a philosophic theory which acquired a religious character in the hands of the followers of Buddha. Conversely, many systems of philosophy are attempts to support religious dogmas by rational argument apart from supernatural revelation.

The idea of life beyond the grave has long since furnished one of the principal bases of various philosophic doctrines, the ultimate object of which was to solve the problem of death. Ancient philosophy is full of such. Plato describes the tragic death of his master Socrates, and in connection with it expresses very clearly his ideas upon death. He puts these words in the mouth of Socrates :—

" Far from being depressed by the death of a friend, I felt, on the contrary, that he was to be envied; as I witnessed his attitude, and listened to his words, and noticed the courage with which he faced death, I became convinced that he did not quit this life without some divine support that drew him towards another world in which he would find the most perfect happiness man could wish. . . . In truth, if I did not expect to find in another life gods at once good and wise, and men better than those of this life, it would be foolish of me not to be disturbed by the approach of death. But I know that I look to finding myself among just men. I do not fear to die, because I am confident that something still remains after this life, and that, according to the old belief, the good will be treated better than the bad."

As such views were not derived from a body of revealed

truth, it was necessary to support them by reasoning. Plato therefore went on to try to convince us of the immortality of the soul by the speculative doctrine of metempsychosis, and suggested that the souls who had abandoned themselves to injustice, tyranny, and plunder would pass into the bodies of wolves and hawks and falcons, for souls of that nature could not go elsewhere; while the souls of those who had practised the social and civic virtues known as equity or justice would inhabit the bodies of peaceful and gentle creatures such as bees and ants, or would even enter other human bodies and again become good men.

Plato referred also to the law of contrasts in support of his theory. "As the most strong often springs from the feeblest, or the most swift from the slow, so life gives rise to death, and from death life springs." "From that which is dead," said Socrates, "is born all that lives and has life. And so our souls after death pass to the infernal regions." "As we must grant that the dead are born from the living as much as the living from the dead, it is plain that the souls of dead men exist somewhere, whence they may return to life."

The doubt which was only latent in Plato was much more active in some other ancient philosophers. Aristotle at first believed that part of the soul was immortal and part mortal. The two parts came together at the beginning of life and separated at its end. Later on, however, Aristotle abandoned the theory of the immortality of the personal consciousness, and argued strongly against the Platonic theory of the immortality of the soul, although he still believed in the indestructibility of the "rational spirit."

The Stoics yet further developed this conception; they held that besides the individual soul there was a universal one.

Cicero, again, discussing old age and death with Scipio and Laelius, tried to establish belief in a future life thus :—

" I am convinced that your illustrious fathers, who were so dear to me, are still full of life, and of the only life worthy of the name; for the body is, as it were, our prison-house, within which we must accomplish the tasks laid on us by necessity. When I think of the activity of the human spirit, its vast memory, its prevision, its store of art and knowledge, and experience, I am convinced in the depths of my being that an existence with such qualities cannot be mortal. The soul is continually active, and its activity comes not to it from without; the soul is a self-supporting activity, and cannot come to an end. Moreover, as the soul is a simple substance, unalloyed by any mixture of materials, it can neither be divided nor made to perish."

In the end, he saw the weakness of his proof, and a note of scepticism appeared in him so that he came to say as follows :—

" If I am deceived as to the immortality of the soul, I am deceived gladly, and I would not have the belief torn from me while I live. If, when I am dead, all feeling is arrested within me, as some pretended philosophers hold, at least I have not to fear that after my death they will come and mock me for my error."

Scepticism becoming more and more definite, belief in the immortality of the soul persisted only in the purely religious form. Philosophical systems freed themselves of it, and replaced it by a vague form of pantheism.

Seneca tried to support the thesis of immortality, but he conveys the impression that there was no vigour in his belief. He is content with poetry rather than with reason.

" The events of this mortal life," he wrote in one of his celebrated *Letters*, " are the mere prelude of a better and more lasting existence. As our mother's womb, bearing us for nine months, shapes us not to live there for ever, but for our place in this world in which it places us, with the strength to breathe this air and to withstand surrounding things : so, also, the time that passes from our infancy to our old age is a preparation for a second birth. Another beginning and another world await us. Until then, we could not endure, save from afar, the splendour of the heavens. Learn then, O man, to face without a shudder the decisive hour, the last hour of the body, but not of the soul.

What you see around you consider but as the furniture of an inn; soon you are going further on. The day that you dread as your last day is your birthday into immortality."

In the midst of these glowing visions, however, Seneca is assailed by dark and gloomy thoughts.

"Yes," he cried, "all that is must perish; death comes to every living thing. Every day, every hour, reveals to man the coming of death; there is always some new lesson to remind him of the fragility he had forgotten, and from a dream of eternity to turn his thoughts to the grave. . . . All beings pass through definite stages; they must be born, grow, and die. The stars that we see revolving above us, the earth on which we are carelessly scattered and which seems to us so solid; all is threatened and all will come to an end. Old age comes on everything; although the period is very different, the same end comes to everything. Everything that now is will cease to be; but for all that the world will not perish; it will dissolve. Dissolution is destruction for us. As a matter of fact we think of things only as they concern ourselves; our degenerate soul, incapable of detaching itself from the body, sees nothing beyond that; none the less we should endure the idea of the death of ourselves and of those near to us with a greater fortitude were we to realize that nature is a constant routine of birth and death, that all composite bodies must dissolve, that the dissolved substances re-form, and that the creative power of God displays itself in this cycle of change throughout the universe. . . . A great soul should know how to obey God and submit willingly to the order of the universe. If it be not for a better life that we are to quit this life, if not to find a home in the skies more tranquil and more brilliant, our souls, free from suffering, will return to the spirit that gave them birth and will mingle in the great all."

The conceptions of the Stoics, especially in the form presented by Seneca, found an ardent and brilliant exponent in Marcus Aurelius, whose *Meditations* are known to all the world. He had much to say of the problem of death and of the attitude of the philosopher towards it.

"Death," said Marcus Aurelius, "like birth, is one of nature's mysteries. In the two are present the same elements: in the one case in the phase of combination, in the other in that of dissolution." In death "there is nothing repugnant to the essence of an intelligent being, nor to the general plan of our nature. . . . Death may perhaps be a dispersal or resolution into atoms, or an annihilation in the sense of extinction. . . . Alexander of Macedon and his mule-driver were reduced at death to the same condition—that is to say, they returned alike to the originating

principle of the universe, or one and the other were scattered as atoms."

Although he was definitely a deist, Marcus Aurelius was undecided as to the immortality of the soul, for he goes on, "If souls have not disappeared, how can the air contain the eternal generations of them? . . . Remember well that that feeble and composite creature, your soul, will one day resolve into its atoms; the faint spark of life will be extinguished, or be assigned to some other dwelling-place." Clearly enough, there was no consoling hope of a future life to be derived from these halting dubieties. It was needful to replace by some other anodyne the belief that for so long had brought comfort to poor humanity.

Marcus Aurelius tried to counteract the fear of death by the following reflections :—

"To fear death is to fear either being deprived of all feeling or being subjected to some other kind of feeling. But, if we are deprived of all feeling, we shall have no evil to fear; if we are to find new kinds of sensations, our existence will be different, but still existence."

However, he probably realized the weakness of such a consolation, for he tried to link the problem of death with the general principles of human conduct :—

"The fig tree lives according to its kind, the dog like the dog, bees like bees, and man like man. . . . Man must live in conformity with the laws of his nature. . . . No one will prevent you from living according to the laws of nature, and nothing can happen to you that is not in accordance with nature's universal law. . . . Neither hand nor foot can do that which is contrary to the laws of nature, because the foot can only fulfil the functions of the foot, and the hand those of the hand. Similarly with man, to behave as a man is not to defy nature's laws, because it is only fulfilling the functions of man. And that which is not against nature cannot be evil. . . . For, after all, nature forges the links and nature breaks them. Is she about to sever them? Very well, let us then say farewell as if we were taking leave of our friends, but let there be no tearing of the heart strings, and let us go willingly, and so avoid being dragged away. This, too, is in accordance with the laws of nature. . . . Philosophy is to await death peacefully, and to regard it as merely

the dissolution of the elements which compose the human frame. Such is the law of nature, and whatever is in conformity with nature is not evil. . . ."

Resignation, then, is what this form of philosophy amounts to.

In his book on Marcus Aurelius, Renan compares his philosophy of resignation with the Nirvâna of the Buddhists. "Like Jesus, Sakya-Muni, Socrates, and Francis of Assisi, Marcus Aurelius was victor over death. He could laugh at it, because it had no longer any meaning for him." But, just as the theories of Buddha became transformed into a religion which promised the immortality of the soul, and as Nirvâna gave way to the Paradise of the Easterns with its delights, so the sceptical resignation of ancient philosophy was vanquished by Christianity with its promises of a future life and immortality.

Although Spinoza had given up the conception of the immortality of the soul in the ordinary sense, he accepted the Aristotelian idea that "the human spirit could not be destroyed absolutely with the body, but left some eternal remnant." Death, in his view, was a kind of eternal life, a merging with the "Absolute," a return to the immortal and universal substance.

Many philosophers have studied the foundations of knowledge with the sole object of demonstrating the truth of religious dogmas. In spite of his scepticism, Kant tried to prove the genuineness of human knowledge, and to found on that a conviction of the future life and of the existence of God. Fichte set himself the same task, but he was forced to recognize that "immortality cannot be deduced from natural phenomena," and that it "is supernatural." "Although we cannot understand the possibility of eternal life, it still may be possible, for it transcends human knowledge." Hegel reached a pantheistic conclusion and believed in the human soul being re-absorbed by the "Absolute."

These idealistic systems, when they reached their final point, provoked a reaction consisting in the rejection of all formulas based on speculation. They were succeeded by a dogmatic materialism, which in its turn gave place to a sceptical positivism, or rather to a form of agnosticism. Granted the impossibility of belief in the immortality of the soul or in eternal life in any shape, the philosophy regarding death was reduced to the stoical idea that our end is in harmony with the laws of nature, and that it must therefore be accepted without protest. Resignation, in the fullest sense of the word, became the watchword of human wisdom.

It was only to be expected that certain courageous and independent thinkers should disagree with this conclusion, and attempt to discover some other solution of the great problem absorbing mankind. Thence arose the prevalent philosophic theory of pessimism. Like belief in immortality and the advocacy of resignation to the evils which beset humanity, pessimism is the product of the East, and India was probably its nursery. A pessimistic view of life is a salient feature of Brahmanism, but Buddhism develops even more fully the doctrine that everything of this world is evil. That life is made up of suffering is the inexhaustible theme which the Buddhist Scriptures din ceaselessly into our ears.

There is no such thing as individual immortality. But, according to Schopenhauer, to desire such immortality would merely be to advocate " the eternal perpetuation of a great mistake. Each individual existence is a definite mistake, a blunder, something that would better not have been, and the object of existence should be to end it."

But if man, as an individual, is mortal, " death only takes away what was given by birth—that is to say, the principle by which death itself became possible. . . .

Consciousness ceases at death, but the cause which produced that consciousness persists; life comes to an end, but not the principle which became manifest by life."

What then is this immortal principle? It is the idea of the species or genus. Men or dogs, as individuals, perish in due course, but the human species or the canine species, the man "idea" or the dog "idea," endures. Here Schopenhauer reverted to the conception of Spinoza, who, indeed, denied the immortality of the soul but none the less believed in the immortality of the principle of life. This everlasting principle, according to Schopenhauer, is the will in its widest and most metaphysical sense, while, on the other hand, the mortal soul is the reason, a product of the functions of the brain.

The eternal principle of life cannot be defined, because "we cannot pass outside the limits of our consciousness. And thus the problem of what it is in itself cannot be resolved."

The will to live manifesting itself, according to Schopenhauer, by the creation of new individuals, the philosopher would naturally, in accordance with his views of life, abstain from bringing others into the world. Schopenhauer lived and died a bachelor, and, so far as I am aware, had no children. On the other hand, convinced that the solution of life's problem did not lie in suicide, he clung tenaciously to life. Having relinquished a belief in the immortality of the soul, he fell back upon a belief in the persistence of some ultimate principle apart from conscious life, and held that in resignation and desire for annihilation lay the true consolation for all the evils of human existence.

For a long time Schopenhauer's views found no echo in the opinions of other thinkers. Later, however, they became more and more widely diffused, and philosophic pessimism became quite fashionable. Those who did not

adopt the metaphysical principles of Schopenhauer's philosophy agreed with his outlook on life and on the impossibility of happiness.

Exactly half a century after the publication of Schopenhauer's philosophical views another German philosopher, E. Hartmann, went a step further in the same direction. Without agreeing wholly with his metaphysics, he shared Schopenhauer's views on the impossibility of regarding happiness as the true aim of existence. In order to demonstrate this theory, he examined the three phases of illusion through which mankind passes. He held that, in the first phase, people imagined happiness to be attainable during the present life; in the second phase they persuaded themselves of happiness in a life after death in another world; and in a third phase they held that this happiness will be attained only in some future state of the cosmic process. However, all that have been regarded as the sources of joy—youth, health, desire, conjugal love, family love, glory, etc.—end in disillusion. Love itself is especially submitted to Hartmann's implacable criticism. According to him, there can be no question but that "love causes far more suffering than pleasure to those concerned." "It cannot be doubted," he says, "that reason would prompt a total abstention from love," and, as a means to this end, he recommends "the extinction of sexual desire by castration, if that could be relied upon to destroy desire." That, according to Hartmann, "is the only possible means of securing the happiness of the individual." It is at the sacrifice of his personal happiness that man permits himself to love, and so abets the evolution of the cosmic process.

Hartmann's proposed solution of the problem of human existence belongs undoubtedly to the category of systems advocating resignation. He is unable to tell us what is

the cosmic process to which he bids man lend all his forces. He advises humanity to continue to live and to multiply in the full certainty that happiness cannot be attained. Hartmann obviously demands a true renunciation and an absolute submission. His solution has the appearance of being more exact, and of furnishing a guide to human conduct more clear than that vague aspiration to Nirvâna proposed by Schopenhauer. But on closer investigation it becomes at once plain that the greater precision is illusory.

It is easy to see, in such circumstances, that a school of criticism of, or negation of, pessimistic doctrines should have gained many adherents. Very few, on the other hand, have embraced pessimistic doctrines because of any power being inherent in them to resolve the difficulties of life. A German pessimistic philosopher, Mailaender, shared fully Schopenhauer's opinions as to the misery of human life, but opposed the latter's doctrine of resignation and Nirvâna as the solution of the general problem of life. Mailaender accepted the three stages of human illusion as expounded by Hartmann, but attacked vigorously the view of facilitating the cosmic process by acquiescence in the will to live.

"Indeed," he cried, "your advice is that we should sacrifice ourselves to the cosmos; we are to choose a career, to learn a trade, acquire money, property, fame, power, and so forth; we are to marry and to beget offspring; by such advice you are merely undoing with your own hands the sole merit of your work, the analysis of illusion. You suddenly advise the very man who has got behind all these illusions to succumb to them again, as if an illusion, although it has been recognized, could still deceive and exercise its power."

Mailaender takes an entirely different view of the problem. Like his predecessors, he is convinced of the futility of happiness, but he has achieved an original view of the cosmic process. He holds that an unaccountable and divine Being existed before the creation

of the world. Before disappearing "this divinity gave birth to the universe." By this means, complete annihilation was made possible. "The world," says Mailaender, "is but the means for bringing about a condition of non-existence, and is the only possible means by which that end could be attained. God knew that only by creating a real world could we pass from existence into non-existence." Mailaender regards as certain "that the universe tends towards universal non-existence." This tendency is characterized by the weakening of the total amount of energy, so that "every individual, at the close of the weakening process to which his energy is submitted, is led in the course of his development to the point at which his desire for annihilation may be fulfilled." Life on our planet, he says, ought to be regarded as a halting-place on the road to death. In order to appreciate fully the happiness brought by death, it is necessary first to taste of life, and that is why the instinct of self-preservation is so well developed in animals. Man passes first through a phase of development in which he is like any other animal.

"As with them, the will to live is stronger than the will to die. Life is clung to with extreme pertinacity, and death is proportionately execrated. . . . At first, not only the fear of death increases, but equally the love of life. Terror of death becomes acuter. Animals, knowing nothing of death, only fear it instinctively through their perception of approaching danger. Man, on the contrary, knows of the existence of death and what it means. He looks back on his past life and wonders what the future may hold in store, and realizes, infinitely more than animals realize it, the dangers that threaten him. During this phase, man does all in his power to keep death at bay, and to make his life as happy as possible. This, however, is not the last stage of his development. The thinking man soon comes to the conclusion that a craving for life is not the true aim of the universe; it is only the means for attaining to a knowledge of the definite aim of existence, which is the cessation of life. Philosophy soon shows that perfect happiness is not possible, and that only death is really desirable. In summing up the cosmic process, the conclusion arrived at is that throughout the universe the desire

of death exists in a form more or less masked, but that in the organic world this assumes the form of a will to live." [1]

In the end, however, the desire of death becomes more and more plain, until the philosopher can see "in the whole universe nothing but a longing for absolute extinction, and fancies that he can hear the cry rolling from star to star, 'Deliverance, deliverance, death to our life!' and the echoing cry of consolation, 'Extinction and deliverance await you all!'" True to his principles, Mailaender committed suicide when barely thirty-five years of age.

Maeterlinck, again, echoes all this pessimism :—

"It is plain that from one point of view humanity will always seem wretched, and as though being dragged towards a fatal precipice, since it will ever be doomed to disease, to the inconstancy of matter, to old age, and to death. . . . Yes, human life as a whole is sad, and it is easier, I may almost say pleasanter, to discuss and expose its dark side than to enumerate its consolations and make the best of them. The miseries of life are many, obvious, and never failing; whereas the consolations, or rather the reasons which cause us to fulfil with alacrity the duty of living, are rare, hard to seek, and precarious."

Although pessimism was greatly developed and widely spread during the nineteenth century, dissentient voices were not wanting. The German poet, Robert Hammerling, reproaches the pessimistic philosophers with ignoring the attitude of mind of the majority of mankind who ask but one thing—life—life at any price and under any conditions. Against this sentiment all dogmatic arguments are useless, for, according to Hammerling, the question of pleasure and pain is a matter of feeling and not of reason. Now, with regard to the general feeling of humanity, there can be no doubt—it is frankly optimistic.

Max Nordau thus supports a similar theory :

"The truth is that optimism, limitless and invincible optimism, constitutes the fundamental attitude of man, and is the instinctive

[1] Mailaender.

feeling which governs him under all circumstances. All other forms of life confirm this truth. . . . All nature by the bells of flowers and the throats of her birds, rings and proclaims the truth of optimism. . . . No animals feel the pain of the world; and our own ancestor, the contemporary of the cave bear, was certainly free from all anxiety relating to the destiny of the human race."

These arguments do not take into account that, to be true, pessimism need not necessarily be felt, and agreed with, by all living creatures. Birds and other animals, happy in their lives—that is to say, optimists—know nothing of the inevitability of death. Our cave ancestors knew nothing of it either. If the greater portion of modern humanity is optimistic, that might be accounted for by its being still under the influence of one of the three phases of illusion alluded to by Hartmann. It is only when the highest stage of development is reached that man, being convinced of the futility of his hopes, arrives at a pessimistic conception of the universe.

The feeling of pain is very erratic in both animals and human beings. Quite insignificant causes and unimportant illnesses, such as certain forms of neuralgia, give rise to unbearable agony. A physiological phenomenon such as childbirth is often attended by extremely violent pain which is absolutely useless as a danger-signal. On the other hand, some of the most dangerous diseases, such as cancer and kidney disease, may exist for a long time without causing any pain, with the result that the sufferer knows nothing of the presence of the disease until it is too late.

But when men have passed through the three stages of illusion it is not physical pain which presses most heavily on them. Max Nordau himself admits that it is " appalling to think of the cessation of our consciousness, and the annihilation of our ego." None the less, he believes " that we are so happily constituted as to be able to accept the really inevitable with a light heart,

and that there is no ill feeling about the matter." With very rare exceptions man does not willingly accept the prospect of death, especially if he be still under the influence of illusion in any of its three stages. As a rule those who desire to live feel not only a repugnance to the contemplation of death, but death seems to them something abnormal and irrational. It is no answer to assert that all who feel this are psychopaths, or that it is absurd to think that the happiness of mankind counts for something in the cosmic process. On the contrary, it is quite natural that man should seek after happiness, and that he should try to analyse the phenomena taking place within him and around him from the point of view of that ideal. For this reason it is quite unjust to say that pessimism cannot be treated seriously. It is pessimism which has been the first to draw up a true indictment of human nature, and if pain is to be regarded as useful in its quality of danger-signal we should equally recognize that the pessimistic view of the universe is a step onwards in the evolution of humanity. Without pessimism we might easily sink into a kind of contented fatalism, and end in quietism, in the manner of many religions.

It is only natural, however, that the thinking world should not accept pessimism as the last word of human wisdom, and that more or less noted philosophers should devote themselves to finding a possible solution of the problem of life and death. These systems of philosophy, one and all, have readily abandoned all belief in future life and personal immortality. But they have adopted pantheistic conceptions, and have accepted the existence of some general principle into which the individual consciousness will eventually be absorbed. There is division of opinion as to the properties of this principle. For some it is the Idea, for others Will, for others Eternal Energy.

Renan's ideas may be taken as typical of the compromise between poetry and philosophy. Speaking of immortality, he said that " we shall each live again by the traces we leave on the bosom of the Infinite."

The views elaborated by Guyau are equally poetic. Like so many others he is unable to accept without protest the prospect of the inevitability of death. Brought face to face with this end, he declares that he feels " not sorrow but indignation, as against an injustice of nature." " It is with justice," he cries, " that we look on nature as a murderess if she kills what is morally best in ourselves and in others."

It is chiefly in the name of love that Guyau protests against death : " The death of others, the annihilation of those we love, is insupportable to men, who are essentially thinking and loving creatures."

" One may ask," he says, " if it may not be that these conscious entities, mingling and interpenetrating, may come to live on from one to the other, and so to acquire a new duration ? " On such a hypothesis he can foresee " an epoch not, indeed, certain to come, but far from inconceivable, in which individual consciousnesses will have achieved a corporate integrity and a complex intercommunion, without themselves being lost by the union."

On this hypothesis, " the problem is to be at the same time loving enough and loved enough to live and endure in another. . . . Those who vanish and those who remain must love one another so greatly that the shadows cast by them on the universal consciousness are identical." " We should then feel ourselves passing and ascending from this life to an immortality of love," and " the point of contact between life and immortality would be discovered."

Even Guyau, realizing that his philosophy regarding

the immortality of love fails to reassure those who look to philosophy for some word of consolation, ends by admitting that " as there is no help to be expected from the inexorable, nor mercy from that which is in conformity with the universe and even with our own judgment, resignation is best." As it is the general opinion that to be philosophical is to take things as they are, without undue protest, the watchword of all systems of philosophy is to bow to the inevitable—that is to say, to be resigned to the prospect of annihilation.

CHAPTER XI

WHAT SCIENCE CAN DO AGAINST DISEASE

SCIENCE, the youngest daughter of knowledge, has begun to investigate the great problems affecting humanity. The chief religions and many systems of philosophy had been long established before the spirit of scepticism dared to inquire whether or not these products of the human mind were really in harmony with fact. Scepticism gained ground little by little, and open war was declared between religious dogma and authority on the one side, and scientific reason on the other.

The great religions and the philosophy of Aristotle had ruled a majority of mankind for some twenty centuries before doubt was cast on the real value of these doctrines.

All religions have busied themselves with the cure and prevention of disease. They believed that the causes of these were the influence of evil spirits or the visitations of God; and as remedies they prescribed sacrifice and prayer and anything that might avert the anger of God. Even at the present day, similar treatment is used by primitive races. In Sumatra, for instance, when it is impossible to arrest the flow of blood from a wound, the disaster is ascribed to an evil spirit who is sucking the wound and making it incurable. In Nias, when bleeding from the nose occurs in children, it is supposed to be due to the father having killed a cock during the pregnancy of the mother. The indispensable remedy is to make sacrifice to the outraged deity.

No doubt there co-exist with such practices of primitive

races certain useful rules, based on correct observation or on experience. It is a common practice to try all manner of remedies on the sick; although most do harm, now and again something useful may be discovered. Such primitive medicine has undoubted merit, but it cannot be compared with the results of scientific medicine, which are drawn from rigorous experiment.

Without doubt the fear of disease has played a large part in the pessimistic conceptions of the universe. Not only Buddhism but many other systems of pessimistic philosophy attest this.

Humanity will be fortunate if the pessimistic philosophers prove as wrong about their other grievances as they have proved about disease and medicine. To understand the vast progress made by medicine, it is necessary only to compare the complaint of Schopenhauer with the actual state of affairs. Experimental science has proved that he was quite wrong. The great affections of which he spoke, cholera and plague, are due not to chemical changes in the air but to specific microbes, the natural history of which is known as well as that of any other plant.

Plague is not the manifestation of the anger of God, but is a scourge due to invasion by a minute organism, discovered simultaneously by Kitasato and Yersin in 1894. The microbe may live not only in human bodies but in the bodies of rats which live in association with man. These animals are the source of human infection, and it is necessary to destroy them as completely as possible. There is no doubt but that the arrest of the plague in the seventeenth century was due to the fact that rats had themselves been exterminated by the plague.

In such countries as India in which plague still causes great losses, we have to blame the ignorance of the

population. Instead of following the course prescribed by science, these people still prefer the rules laid down by the Brahmanistic religion. Their idea of cleanliness and purity is a religious idea and not that of medicine and bacteriology. It is not surprising that plague still exists in India, but none the less no case is a better instance of the progress of knowledge.

A great stimulus was given to medicine and surgery by the knowledge gained by Pasteur in his study of fermentation. He showed that fermentations were chemical alterations in organic matter, excited by the presence of minute organisms.

This discovery was applied in the first place to surgery. Lord Lister showed that the festering of wounds was due to the entrance of these minute organisms. Following this clue, he succeeded, by the use of dressings, in preventing the contamination of wounds and at once saw a vast reduction in deaths following surgical operations. Since the discovery of anæsthetics, such as ether, chloroform, and cocaine, and the use of germ-free dressings, surgery has been developed in a marvellous fashion. The varied and delicate feats of abdominal operation are known to all, and recently surgery of the heart has become possible.

New medical knowledge, founded on the discovery of the nature of ferments and of the virus of infection, has reformed the practice of midwifery to such an extent that puerperal fever, formerly one of the great scourges of humanity, is now extremely rare.

Blindness acquired at birth, which formerly ruined many lives, is now practically prevented by means of the precautions taken to ensure that the eyes of the child are not contaminated by the infected vaginal excretions of the mother in the process of birth.[1]

[1] See Appendix IX.

Working with Chamberland and Roux, Pasteur demonstrated that many infectious diseases could be prevented by the use of attenuated virus; he succeeded in saving the lives of many animals and of men bitten by rabid dogs and infected by hydrophobia, a disease formerly almost invariably fatal and among the most horrible to which man is liable.

Among recent discoveries, I may mention that of the curative properties of the blood-serum of animals which have been subjected to the action either of microbes or of the soluble products of microbes. Von Behring, working with Kitasato, a Japanese investigator, has shown that a serum of this nature, prepared with the poison produced by the microbe of diphtheria (the poison was discovered by Roux in collaboration with Yersin), is capable not only of protecting those in good health from diphtheria, but of curing those who have been attacked by the disease. The serum fails to act only when it is employed in advanced cases of diphtheria.

Anti-diphtheritic serum has been tried in every way and has been proved to possess both preventive and curative properties. If patients still die from diphtheria, it is only because the treatment has been applied too late or insufficiently.

The beneficent discovery of the curative value of serums has been applied to other diseases and is giving very encouraging results.

To diminish the spread of tuberculosis, of typhoid fever, of dysentery, and of many other diseases, it is necessary only to follow the rules of scientific hygiene, without waiting for specific remedies.

There are few maladies more terrible than cancer, for it practically never disappears spontaneously, and surgery can remove it successfully only if it has been recognized at an early stage. Every year a number of persons,

old and young, die victims of malignant tumours, and cancer is more prevalent now than in former times.[1] It has been suggested that this increase of cancer is due to the greater longevity among modern races, and, as malignant tumours are most common in old persons, it may well be that the prolongation of life has given this disease a larger field.

Unquestionably the malignant tumours are the diseases most disappointing to medicine and surgery, and these sciences are as much at a loss with regard to them as in the case of infectious diseases before the discovery of pathogenic organisms. Science is perhaps even in worse case with regard to cancer than it formerly was with regard to infectious diseases, for, before the discovery of microbes, something was known of the virus which produces infection. Thus the virus of smallpox was known, and was used by the method of inoculation to prevent more serious attacks of the disease. Nearly a century before the discoveries of Pasteur, Jenner had been able to be of the greatest service to mankind by his discovery that the virus of cow-pox could be used as a preventive of infection by smallpox.

In the case of malignant tumours, we do not even know their real nature; we are ignorant as to whether or not they are infectious, and whether they are caused by a microbe coming from without or are due to internal changes of the tissues. Our ignorance, however, affords no ground for despair. It is probable that the malignant tumours will soon come to be ranged with infectious diseases due to invasions by specific microbes. Experiments on the cancers in rats and mice have shown that these can be inoculated in the same manner as in the case of the recognized infectious diseases.[2]

The prevention and treatment of disease, which for

[1] See Appendix V, page 201. [2] See Note on page 137.

long was in the hands of religious authorities, is now passing into the care of those who employ the methods of scientific medicine. It is now only in the case of certain nervous maladies, which can be treated by suggestion, that religion has any important part to play.

Science is capable, no doubt, of assuaging humanity in its sufferings from this or the other disease. But there is another question. Disease is only an episode in human life, and the great problems remain unsolved by science. It is not enough to cure a man of diphtheria or intermittent fever; it is necessary to explain what the destiny of man is, and why he must grow old and die at a time when his desire to live is strongest. Here, plainly, all science must fail, and here must begin the beneficent work of religion and philosophy. But as science is constantly casting doubt on the dogmas of religion, and criticizing adversely the systems of philosophy, it is plain, that so far from being of service, science is actually harmful to mankind.

The campaign against science was opened long ago. In the eighteenth century Rousseau opened it with brilliancy and zest worthy of his reputation. He defended his theme with vigour and eloquence and the following quotations may serve as an example :—

" Know, O people, that nature has desired to preserve you from science as a mother tries to snatch a dangerous weapon from the hands of her child; that the secrets which she has hidden from you are evils from which she would preserve you, and that one of her greatest gifts is the difficulty with which knowledge is acquired. Human beings are perverse, but they would have been worse had they had the misfortune to be born learned men. Our sciences are futile in so far as they fail to attain their objects, but they are worse than futile in the results that they bring about. Born of idleness, they cherish their mother—Tell me, illustrious philosophers, you from whom we know why matter attracts matter, the relations of the orbits traced by revolving planets, the mathematical properties of curves, what stars may be inhabited, what insects exhibit curious modes of reproduction; tell me, I say, you from whom we have gained such marvellous

information, if you had never learned of these things, should we have been less numerous, less well governed, less flourishing, or worse disposed? "

Such words were capable of impressing men because of their eloquence and sincerity, but they could not arrest the continued and triumphant advance of science, which indeed, precisely at the end of the eighteenth century, began its modern and lasting progress. For it was then that Laplace described the system of the heavens and that Lavoisier laid the foundation of modern chemistry and of our knowledge of the indestructibility of matter.

Tolstoi has attempted to show the incompetence of science with regard to the great problems that occupy humanity. The task set himself by the Russian writer was much harder than that of Rousseau, for science had become much more powerful.

" All that we call culture," Tolstoi affirmed, " our sciences, our arts, improvements in the amenity of life, are no other than attempts to deceive the moral cravings of mankind; all that we call hygiene and medicine are no other than attempts to deceive the physical and natural cravings of mankind."

The whole progress of science " up to the present time, has not only not improved the lot of the majority of mankind—that is to say, of the labourers—but has made it worse."

Tolstoi thinks that the epithet " true science " could be given only to " knowledge of the right aim and true happiness of each individual and of mankind as a whole. Such a science would serve as a guiding thread in determining the proper sphere of all knowledge " ; " without knowledge of the proper aim of life and of the real good of humanity, all other knowledge and every art become merely amusements idle or even harmful."

The chief grievance of the great Russian writer against knowledge, culture, and progress can be resolved into the powerlessness of these to explain the most difficult problems of humanity—that is to say, the real aim of human life, and what really constitutes true happiness.

Büchner, in his treatise on *Force and Matter*, in which he tried to give a general conception of the universe based on the scientific knowledge of the nineteenth century said :—

" We must seek the foundation of morality elsewhere than in the time-worn and fantastic belief in the supernatural. Science must replace religion; belief in the real existence of a natural and immutable order in things must displace belief in spirits and ghosts; natural moral law must take the place of artificial or dogmatic morality."

Büchner even tried to indicate what natural morality is. According to him it is " the law of mutual consideration of the equal rights of each person, both from the general and the individual point of view, so as to assure the greatest happiness of the greatest number. Everything that damages or destroys the common good is ' evil '; everything that favours it is ' good.' "

The question as to whither we are going finds an answer in the scientific materialism of Büchner. He disputes the idea of immortality, which has been supported by nearly all the religions, and comes to the conclusion that

" there is nothing appalling to a man, imbued with the principles of philosophy, in the conception of the annihilation of the individual life. . . . Annihilation is perfect rest; it is freedom from all pain and escape from the sensations that torture the body and the mind—as was explained so clearly in the great religion of Buddha; it is not to be feared, but rather to be coveted when life has reached its normal term and when old age has come with its inevitable assemblage of infirmities."

Büchner has served to a large extent as the mouthpiece of ideas current among the materialistic and

positivist men of science of his time. In Haeckel's book, *The Riddle of the Universe,* which appeared nearly half a century after the first edition of *Force and Matter,* the same ideas are to be found. He also has found answers to the questions that absorb mankind. In his opinion, also, the problem of natural morality resolves itself into the social instincts of man, and has nothing to do with religious dogma. As for the destiny of man, he concludes as follows : " The best end we can desire after a courageous life, spent in doing good according to our light, is the eternal peace of the grave."

While there is no doubt but that such ideas are shared by many men who rely on scientific arguments, there are others to whom the problem presents itself differently. The German physiologist, Du Bois Reymond, after reflecting on the general problems of knowledge and the universe, proclaimed an " Ignorabimus " as a warning that a whole series of problems of the highest importance to humanity were outside the range of human knowledge and incapable of solution. These problems were precisely the seven " riddles of the universe " that Haeckel claimed to have solved in his book.

Many learned men think that the great problems, those, according to Tolstoi, that constitute the only true science, can never be solved. " Every day there comes a new conquest," said Richet, " but we are no nearer solution of the ultimate enigma, the destiny of human life, an enigma probably never to be solved." Philosophers have taken the same view. " It cannot be from science," said Guyau, " that personality is to require the proofs of its own durability."

The answers given by science as she exists to-day have failed to console the minds that have applied to her. When Richet, in the discussion on the " bankruptcy of science " recalled the discovery of treatment of diphtheria

by specific serums as an instance of the value of scientific research, Brunetière replied, "Serum therapy cannot prevent us from dying, nor tell us why we must die." The problem of death always recurs. What is the use of saving the life of a child smitten by diphtheria only that it may grow up, and by learning the inevitability of death become filled with terror?

If science be really powerless before the gravest problems that torture mankind, if she has to excuse herself by admitting her incompetence, if she can do no better than to extol the silent annihilation of the grave, it is not surprising that many minds—and these not the least capable—turn from her. The desire to find some consolation in the miseries of a purposeless existence throws them into the arms of religion or metaphysics. Here lies the explanation of the actual return in these days to faith. People plunge into mysticism hoping to find there something more comforting than the annihilation offered by science.

Having reached the conclusion that life is meaningless because it cannot be harmonized with the fear of death and the prospect of absolute annihilation, Tolstoi asked if it were not possible to solve the great problem of human existence by means of the facts of science.

> "I searched in all the sciences," he said, "and not only found nothing myself, but became convinced that all who sought would find nothing. Not only would they find nothing, but they would clearly see precisely what had driven me to despair, the fact that the absurdity of life is the sole indisputable bit of knowledge open to man. . . . For a long time, observing the grave and solemn tones of the exact sciences, which indeed, hardly touched the problem of life, it seemed to me that they must be concealing something that I did not understand."

Driven in the direction of faith, Tolstoi reached the following conclusion. "The object of a man's life is the salvation of his soul; for that, we must live in God, and to live in God it is necessary to give

up the pleasures of life, to work, to submit, to suffer, and to be charitable." And this conclusion led to the other, that "a faith has value in so far as it gives a meaning to life which is not destroyed by death."

It is plain, then, that all this evolution, the beginning of which was the fear of death, ended in belief in something beyond death. And it is also plain why Tolstoi should have been as bitter against science as I have shown him to be. Tolstoi does not afford the only example of a case where the failure of science to solve the problem of death has led to the abandonment of science in favour of religion. Brunetière, if it is possible to judge from his published writings, traversed similar paths in his journey to the Catholic religion.

However, even an intellect so positive and so sceptical as that of Zola has been unable to resist the lures of faith. There is a very interesting note on this subject in the *Journal* of de Goncourt :

> " To-night, after dinner, at the foot of the bedstead of carved wood, where coffee was served, Zola began to talk of death, on which his thoughts have been fixed more than ever since the death of his mother. After a short silence, he said that death had made an in-road on the nihilism of his religious convictions, as he could not face the possibility of an eternal separation."

In strata of society less impregnated with rational and scientific thought, it is plain that the return to religion must be more common. I recall the case of a woman of the people, a work-woman, who declared that she formerly had had no belief, but that, since the birth of her son, she had begun to believe in the good God, as she was convinced that it was only by such a belief that she could guard the life of her child from the evils of the world.

As things are, it is not wonderful that many people

decline to educate their children in an exclusively scientific spirit, which is destructive to faith, as they cannot substitute for faith something equally consoling. Perhaps ideas of this kind lie behind the story of the apple of the Garden of Eden and the invention of the words of Jahveh : " But of the tree of the knowledge of good and evil, thou shalt not eat of it : for in the day that thou eatest thereof thou shalt surely die." (Genesis ii. 17.) The legend of Prometheus, who stole fire from heaven, and was chained to a rock, is in the same category.

Solomon gave voice to the same idea, in the clearest way, in his words :—

" I communed with mine own heart, saying, Lo, I am come to great estate, and have gotten more wisdom than all they that have been before me in Jerusalem; yea, my heart had great experience of wisdom and knowledge.

" And I gave my heart to know wisdom, and to know madness and folly : I perceived that this also is vexation of spirit.

" For in much wisdom is much grief : and he that increaseth knowledge, increaseth sorrow " (Ecclesiastes i. 16).

Much later, Shakespeare offered to us in *Hamlet* the type of a very highly cultivated man in whom reason and reflection had arrested action. As he could not solve by reason the problems that haunted him, he asked if it were worth while to remain alive. Then followed the famous lines :—

" Thus conscience does make cowards of us all,
And thus the native hue of resolution
Is sicklied o'er with the pale cast of thought."

As so many men of genius have taken the same point of view, it becomes necessary to inquire carefully as to whether or not too much knowledge be harmful to human happiness. If science does no more than destroy faith and teach us that the whole living world is moving

towards a knowledge of inevitable old age and death, it becomes necessary to ask if its ruthless march should not be stayed. Is it that the attraction of mankind to knowledge is as dangerous to the race as the attraction of moths to the light is fatal to these wretched insects?

Note by C. M. B.

There is no evidence that cancer is an "infectious" disease in the ordinary acceptation of the word. Cancer cells *transplanted* to a healthy area in the same, or another, animal multiply by cell-division and reproduce the original type of malignant growth. Moreover, they can be kept growing indefinitely by successive transplantations. Carcinogenic agents—which include no known microbes—induce the disease only after prolonged action. In 1896 Sir Archdall Reid suggested that cancer cells are reversions to the persistently-dividing type of cells that are characteristic, not only of the immature tissues of multicellular animals, but also of such primitive living beings as the unicellular protozoa. His theory is rapidly gaining more and more adherents.

CHAPTER XII

THE SCIENTIFIC STUDY OF OLD AGE

While I cannot share the views of those who turn from science to seek truth and consolation in religion, it would be wrong to ignore or to be indifferent to the existence of that attitude. There are men who are tormented by the contradiction between the desire of life and the inevitability of death, and, when these demand some solution of the problem, it is unreasonable merely to say that they are too exacting and should learn contentment.

If a man complains to his physician of uncontrollable hunger and thirst, he is not told that it is wrong to be greedy, and that the fault can be mastered by strength of mind. The doctor examines the patient and does what he can for the distressing symptoms, which, indeed, in this case are generally due to diabetes. Those who hunger and thirst after eternal life ought to be similarly treated by men of science whose duty it is to ameliorate their sufferings as much as possible.

Science has undoubtedly gone far in the successful treatment of disease, both as regards prevention and cure, but it is powerless before those other evils from which Buddha implored his father to grant him exemption—old age and death.

Not only is no remedy for old age known to science, but little is known with regard to it. With the advance of years, man and the higher animals undergo important modifications. They become weaker, the body shrinks, the hair whitens, the teeth decay, and the body becomes an easy prey to pernicious influences and diseases. The

direct cause of death cannot always be determined, and is then attributed to a general breaking up of the system. The first question which presents itself to the scientific mind is whether this degeneration or senile decay is proper only to man and the higher animals, or is common

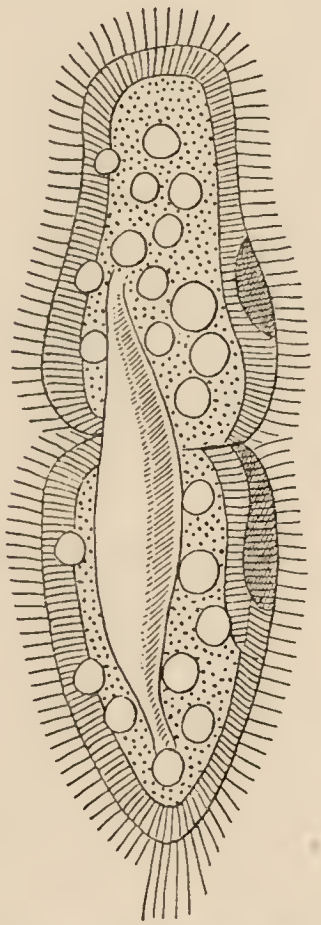

FIG. 9.—PARAMECIUM ABOUT TO DIVIDE IN TWO.

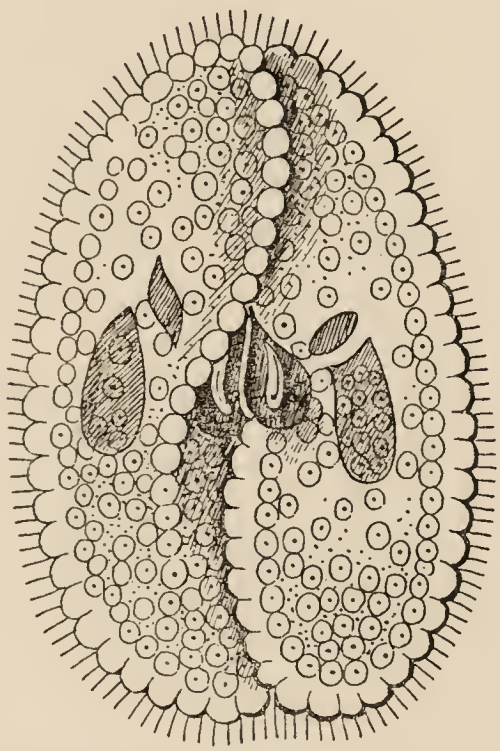

FIG. 10.—CONJUGATION OF TWO PARAMECIA.

to all forms of life. In very old trees the mere appearance proclaims their age; the trunk is decayed, the bark gnarled, the branches shrivelled, and the leaves scanty. Some trees live for thousands of years, while others age with comparative rapidity. Senile decay is, indeed, found throughout the vegetable kingdom, even among creatures of very simple organization such as the infusoria. These creatures may be reared with ease in

vessels containing infusions of chopped hay or leaves. They multiply by means of division (Fig. 9), an operation which takes place at very short intervals, some of them dividing nearly every hour. Owing to this rapid multiplication the liquid is soon teeming with infusoria. M. Maupas observed that the infusoria became smaller and smaller after a number of generations, exhausting themselves, as it were, and perishing unless two individuals succeed in uniting. This process of "conjugation" (Fig. 10) involves an exchange of portions of the bodies of the two creatures and brings about rejuvenescence of the two individuals. After conjugation, a process essentially similar to the details of sexual fertilization, the infusoria resume the normal appearance and again become capable of reproduction by simple division for many generations.

The periodical debility which precedes conjugation is, according to Maupas, an instance of senile degeneration among infusoria. Among bacteria, a group that includes the greater number of pathogenic organisms, conjugation has been very rarely observed.[1] Even the largest kinds—such as, for instance, the *anthrax* bacillus—may be propagated for a long series of generations without the occurrence of conjugation.

Even in the case of the infusoria, which by means of the process of conjugation can reproduce indefinitely, the preconjugal debility cannot be identified with the senile degeneration of human beings, the higher animals, and trees. In all these, debility is the antecedent, not of conjugation and rejuvenescence, but of the end of life.

If, in spite of this difference, we were to insist on the existence of an essential resemblance between senile degeneration in man and preconjugal debility in infu-

[1] The majority of modern bacteriologists regard the evidence of conjugation among the bacteria as most inconclusive.—C. M. B.

soria, it would be enough to reflect on the result of applying to the case of man what is an infallible remedy in the case of the infusoria. For conjugation brings about a real rejuvenescence of the infusoria, and a similar event in the case of an aged man would only increase his debility.

Real old age is a phase of existence in which the natural forces abate, never to be renewed. In animals, the life cycle of which is very definite, the signs of senile degeneration are not visible. Insects, in the adult condition, very often live only a short time, and die without displaying the slightest mark of age. In the case of lower vertebrates, old age is little known, and has few signs. On the other hand, mammals and birds display senile atrophy in a marked fashion.

Some species of birds live to a great age, longevity being more common than among mammals. Cases in which birds such as geese, swans, ravens, and some birds of prey, have been known to reach the age of fifty years, are not uncommon, whereas such an event is very rare in the case of a mammal. Even small birds, such as canaries, may live as long as twenty years. Parrots are especially long-lived birds. Cockatoos have been known to reach the age of eighty years and more. I myself have had opportunities of observing a South American parrakeet which lived more than eighty-two years. Several years before it died the bird showed unmistakable signs of old age; it became less lively, its plumage, although it did not whiten, lost much of its brightness, and the joints of the claws showed evidence of the presence of disease.

Mammals show signs of old age even more plainly than do birds. A dog reveals it by slow movements, white hairs, worn teeth, and impaired eyesight. The appearance of such an animal is never agreeable, and it is

often dirty and ill-tempered. Dogs may live for twenty, six and twenty, or even thirty years, but such cases are most unusual.

As the dog is a domesticated animal, it might be argued that its old age, with its manifest signs of decrepitude, is the result of artificial conditions of life. To decide on this point it is necessary to examine an instance of old age in a wild animal. This presents certain difficulties since wild animals when old and feeble become an easy prey to carnivorous enemies. It will best serve our present purpose to consider such information as has been collected regarding the period of old age in anthropoid apes.

The natives of Borneo have observed "old orangs, which have not only lost their teeth but, being too feeble to climb, live on the fallen fruits and herbs."[1] Gorillas turn grey in their old age, from which has arisen the erroneous view that there are two species of the gorilla.

In their wild state, apes, like ourselves, are subject in their old age to various distressing ailments. Senile degeneration, then, which is universally looked upon as one of the greatest evils of life, is by no means restricted to the human race.

After dealing in broad outline with the physical degeneracy caused by old age, Longet draws the following mental picture :—

"The old feel that their task in life is accomplished, and believe themselves to be universally grudged the space they occupy in the world. This renders them suspicious of all around them, and jealous of the young. Their craving for solitude and the uncertainty of their tempers are due to the same cause. All old people are not like this, of course. The hearts of some remain youthful and beat strongly within their feeble frames, but, as a general rule, they are morose and a nuisance to themselves and others, excepting when they are surrounded by their children or

[1] Huxley, *Man's Place in Nature*.

grandchildren, who like to listen to them about the past, and who make excuses for the present. Thus the years speed onward, every round of the clock bringing the end nearer, and every hour adding a new wrinkle to their faces, some fresh weakness and some new regret. Their bodies . . . become decrepit; their backbones, too weak to hold them upright, curve over and bend them downwards towards the earth."

There can be no doubt but that the period of old age is sad, and a thorough knowledge of it is necessary before it can be understood. Disease can be successfully dealt with only when the cause of its presence is known, and so it is with old age.

It is common knowledge that the flesh of old animals is tough. An old fowl cannot be compared with a tender and juicy chicken. Organs such as the liver and kidneys are much harder in the case of old animals. The tough flesh of old animals is often compared with boot-leather. Although the comparison does not pretend to be scientific, it is far from being incorrect. Boot-leather is made from the hides of animals—that is to say, of a very resistant material that is called "connective tissue," and which consists of a dense mass of fibres, mingled with the living elements or "connective tissue" cells. This tissue is very durable and so is employed for boots and shoes.

The infiltration of any organ with connective tissue makes it tough and unpalatable. This hardening is called *sclerosis* (of the liver, kidneys, etc.). In old age many organs exhibit this tendency to hardening or sclerotic degeneration. Demange, writing on the organic changes associated with old age, states as follows :—

"Besides atrophy and degeneration of the parenchymatous elements,[1] there is to be observed a profound change in the framework of connective tissue, which serves to support the organs. In some cases the skeletal framework of an organ becomes more

[1] The parenchymatous elements are the most important cells of the organs—*i.e.*, of the liver, muscles, brain, etc.—C. M. B.

conspicuous, simply on account of the degeneration of the cells; this is the condition usually present in the liver of aged persons. More often, however, the connective tissue receives some kind of stimulation, which, although it does not amount to inflammation, brings about an active growth and resulting sclerosis. According to the particular case, the hardening occurs in the form of isolated patches or strands, or affects the whole periphery or even the depths of the organ, and smothers the higher elements in its meshes, so producing a further degeneration. The cellular elements disappear gradually, connective tissue taking their place, and the change may be so profound, that, as in the case of the prostate gland, the altered organ may actually transcend the normal size, partial or general atrophy, however, being more often the result."

Cazalis long ago originated the oft-repeated aphorism : " A man is as old as his arteries," these vessels, by means of which the blood is distributed throughout the whole system, being of immense importance in the economy of the organism. When the connective tissue is so freely developed as to cause a hardening of the arteries, these are hampered in the exercise of their function and become very brittle.

It might fairly be supposed that the hardening seen in many organs of the body during the period of old age is universal, and lends greater strength to the frame. The bones, which are separated from one another in youth, become welded together in old age owing to the calcareous deposits in the joints, and the ossification of the joints between the vertebræ frequently causes the backbone to assume the appearance of a continuous bone, the greater part of the cartilage having become ossified. In old age, the human frame becomes lighter and the total quantity of component mineral substances becomes less; this brings about a liability to fracture of the bones in old people.

Merkel, speaking of certain tissues of old people, such as the skin and the mucous membrane, showed that they preserve their youthful characters to the end,

whereas others, such as the connective tissues, display degenerative changes.

Later I gave a summary of my own conclusions in the following words: "In senile atrophy the same condition is always present: *the atrophy of the higher and specific cells of a tissue and their replacement by hypertrophied connective tissue.*" In the brain, the nerve-cells disappear—that is to say, the cells which subserve the higher functions such as intellectuality, sensation, control of movement; and these are replaced by elements of a lower kind, in especial by neuroglia, the connective tissue of the brain. In the liver, the hepatic cells of great importance to the nutrition of the organism are replaced by connective tissue. In the kidneys, that tissue invades and blocks the tubes by which the necessary process of eliminating soluble waste matter is accomplished. In the ovaries, the ova, the specific elements which serve to propagate the race, are similarly eliminated and replaced by granular cells. In other words, a conflict takes place in old age between the higher cells and the simpler or primitive cells of the organism, and the conflict ends in the victory of the latter. This victory is signalized by a weakening of the intellect, by digestive troubles, and by lack of sufficient oxygen in the blood. The word conflict is not used metaphorically in this case. It is a veritable battle that rages in the innermost recesses of our beings. Distributed throughout every part of our bodies are certain cells which fulfil special functions of their own. They are capable of independent movement, and also of devouring all sorts of solid matter, a capacity which has gained them their name of phagocytes or voracious cells. The function these phagocytes fulfil is a very important one, for it is they that congregate in vast numbers around microbes or other harmful intruders in order to devour them. Effusions of blood and other

elements, on penetrating to parts of the body where their presence is disadvantageous, are absorbed by these phagocytes. In cases of apoplexy, where blood is shed into a part of the brain, setting up paralysis, the phagocytes gradually cluster round the clot and absorb it. This absorption is a lengthy process, but by degrees, as the pressure of the effusion of blood is removed from the brain and paralysis disappears, the health of the organism may become completely restored, recovery in such a case being due to the work of the phagocytes. After childbirth, when the uterus presents the appearance of a great open wound clotted with blood, it is again the phagocytes that clean it and re-establish the normal condition. It is plain, therefore, that the part played by these cells is beneficent.

The phagocytes may be divided into small active phagocytes, generally known as the microphags, and larger phagocytes called macrophags, which are sometimes active and sometimes still. The former, which are produced in the marrow of the bones, circulate freely in the blood, and occur as some of the white blood corpuscles or leucocytes. They are distinguishable by their oval shape which facilitates their easy passage through the smaller blood-vessels, and allows of their accumulating in great numbers in the exudations that form around microbes. These exudations may be formed extremely rapidly, and so may arrest infection in the case of many diseases.

The absorption of extravasations of blood and the healing of wounds are the work of the macrophags. In a general way, the microphags may be said to rid us of microbes, and the macrophags to heal mechanical injuries, such as hæmorrhages, wounds, and so forth. Macrophags, which possess a single unlobulated nucleus, also occur as white corpuscles in the blood, lymph,

and exudations, or as the fixed cells in connective tissues, the spleen, the lymphatic glands, etc.

The phagocytes are endowed with a sensitiveness of their own, and by means of a sense of smell or taste are able to recognize the nature of their surroundings. According to the impression made upon this sense, they

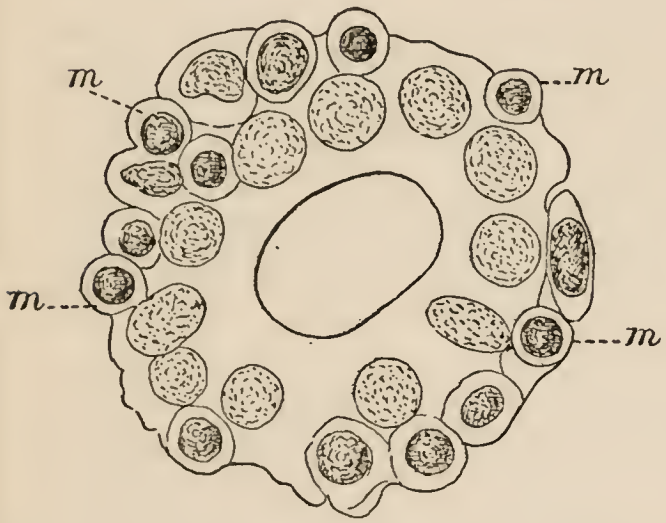

FIG. 11.—SECTION OF A RENAL TUBULE, INVADED BY MACROPHAGS, FROM THE BODY OF AN OLD MAN OF 90 YEARS. *m* = macrophag. (*From a preparation made by Dr. Weinberg.*)

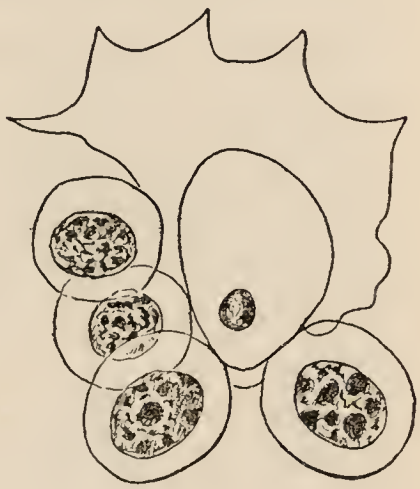

FIG. 12.—CELL FROM THE BRAIN OF A WOMAN 100 YEARS OLD BEING DEVOURED BY MACROPHAGS. (*From a preparation made by Dr. Philippe.*)

approach the object which arouses it, exhibit indifference to it, or withdraw from its vicinity. When, however, an infectious microbe finds its way into the body, the microphags are attracted by its excretions and swarm around it. The macrophags play a very important part in bringing about senile decay. The atrophy of the kidneys in old persons is attributable to their agency (Fig. 11). They accumulate in large quantities in these organs, clustering round about the renal tubes which they ultimately cause to disappear. Having appropriated the place of the renal tubes, the macrophags proceed to form connective tissue, which thus takes the place of the nor-

mal renal tissue. A similar process occurs in the other organs that degenerate in old age. In the brains of old persons and animals, for instance, it is known that a number of nervous cells are surrounded and devoured by macrophags (Fig. 12).

So universal a symptom of old age is the invasion of the tissues by macrophags that it must be regarded as of immense importance. In order, however, to determine more precisely the nature of the function fulfilled by these phagocytes, it was necessary to select a specially favourable subject of investigation. My choice fell upon an examination into the causes of the hair turning white,[1] that being as a rule the first visible sign of approaching old age.

Hair, before it has lost its colour, is full of pigment scattered throughout the two layers of which each hair is composed. At a given moment, the cells of the central cylinder of a hair become active, and proceed to devour all the pigment within their reach. Once they are filled with coloured particles, these cells, which are a variety of macrophag (chromophags), become migratory, and, quitting the hair, either find their way under the skin or leave the body (Fig. 13). The colouring-matter of the hair is removed in this way by chromophags, leaving the hair colourless.

The process by which hair becomes white is of importance, because it shows that the activity of macrophags is a dominant factor in bringing about senile decay. The brittleness of old people's bones is probably due to a similar cause—*i.e.*, to the absorption and destruction of the framework brought about by macrophags invading the layers of bone.

The activity acquired by macrophags during old age

[1] *Annals of the Pasteur Institute*, 1901.

is closely connected with the phenomena that are characteristic of certain chronic complaints. Sclerosis in old persons belongs to the same category as the sclerosis set up by various morbid influences. The analogy between senile decay of the kidneys and chronic nephritis, commonly called interstitial nephritis, is incontestable. The destruction of nervous cells through the agency of macrophags, which we have already mentioned as occurring in old age, is equally a symptom of several diseases of the nervous centres, such as general paralysis of the insane. Arterial sclerosis in old persons is an inflammatory disease, similar to the inflammation of the arteries set up by other maladies.

FIG. 13.—HAIR ABOUT TO BECOME GREY. TWO CHROMOPHAGS CARRYING AWAY THE PIGMENT GRANULES.

The similarity between senility and disease has long been recognized, and partly accounts for the repugnance

we all experience at the approach of old age. An instinctive feeling tells us that there is something abnormal in old age. It cannot be regarded as part of a healthy physiological function. No doubt, because old age is the inevitable lot of mankind, it may be termed normal, in the same fashion as we call the pains of childbirth normal, since few women escape them. In both cases, however, we have to deal with pathological rather than physiological conditions. Just as every effort is made to relieve the sufferings of a woman in labour, so it is natural to try to suppress the evils accompanying old age, but, whereas in childbirth an anæsthetic affords relief, old age is a chronic malady, a remedy for which is much harder to find. We have seen that in old age a struggle takes place between the higher elements and the phagocytes, the end being usually a weakening in vitality of the former, while the activity of the latter is enormously increased. It would appear, arguing from this, that one means of fighting against old age, pathologically speaking, would be to strengthen the higher elements of the organism and to weaken the aggressive capacities of the phagocytes. The properties of cellular elements are easily changed when subjected to various influences, and it is therefore not irrational to seek some means of strengthening the blood corpuscles, nerve cells, liver cells, muscular fibres of the heart, and so forth. The task has become easier since the discovery of serums that have specific actions on the tissues.

We have seen that there are serums which give precipitates only with the blood of man and of his near relatives the anthropoid apes. A serum of this kind has a definite specific action. Serums may be prepared that dissolve only the red corpuscles of particular species of animals, and that are without action on the other organic elements. It has been found possible, even, to prepare

a serum that arrests instantaneously the movements of human spermatozoa, and that is neutral to the similar cells of other animals.

These serums are all prepared in the same way. The cellular elements in question, spermatozoa or red corpuscles, cells of the liver or of the kidney, taken from one animal, are injected into an animal of another species. After several injections have been made, the serum of the animal operated on becomes active with respect to the cells introduced into its body. These serums, which were discovered by J. Bordet of the Pasteur Institute, are specifically *cytotoxic*—that is to say, they poison particular kinds of cells.

Now it has been shown that such serums, employed in small doses, do not kill or dissolve the specific tissue elements, but actually strengthen them. Here the case is analogous with the action of poisons, such as digitalis, which kill in strong doses, but which in weak doses improve or strengthen the action of certain tissues. In accordance with this indication, experiment has shown that small doses of a serum which is capable of dissolving the red corpuscles of human blood actually increase the number of those in the body of a patient treated by injections. In the same way, in the case of a serum large doses of which destroy the red corpuscles of a rabbit, small doses increase the number of these elements in the blood.

Here there seems to be a rational method by which we may strive to strengthen the higher elements of the human body, and so prevent them from growing old. The task, at first sight, indeed, seems an easy one, only necessitating the injection of a horse (or other animal) with finely minced human organs, such as brain, heart, liver, kidney, etc., after which, in a few weeks, serums could be drawn off capable of acting upon those

organs. In reality the process would be a very difficult one to carry out, as human organs are rarely obtainable in a condition suitable for injecting into animals. Post mortems cannot be legally made until twenty-four hours after death, and there are many other obstacles in the way of removing organs from dead bodies. Even if all these difficulties were overcome, another difficulty that would present itself would be the experimenting with various doses of cytotoxic serums of various strength. It is, therefore, not to be wondered at that the attempt to reinforce the higher elements of the human organism will require much time.

The similarity between senile decay and the diseases entailing atrophy in the more important human organs suggests a similitude in cause. Scleroses of the brain, kidneys, and liver frequently originate in intoxication by poisons such as alcohol, lead, mercury, and so forth, or the disease may be induced by some virus, the virus of syphilis being a common cause.

The immense importance of venereal disease as a malevolent factor in the phenomena of old age is especially manifested in arterial sclerosis. Syphilitic virus and alcohol act as poisons which bring about, first, degeneration and brittleness of the arterial walls, and eventually a weakening of the higher elements of the organism. The phagocytes, being cells of an inferior order, are less sensitive to these poisons, which accounts for their victory over the poisoned elements. Rheumatism, gout, and infectious diseases play only a secondary part in setting up arterial sclerosis.

The human intestine contains an enormous quantity of bacteria, which are capable of increasing at the rate of 128,000,000,000,000 each day.[1] These microbes, of

[1] This, of course, applies only if conditions are favourable and the rate of multiplication can go on unchecked indefinitely,

which there are few in the digestive portion of the alimentary canal, are very numerous in the large intestines —*i.e.*, in the lower part containing the waste material. The remains of undigested foods and the mucous secretions form a medium very favourable to the growth of microbes. This bacterial flora constitutes a third part of the human excreta. It is very varied, and contains an immense number of different species, among which are bacilli, cocci, and many kinds of other bacteria about which little is known. The distribution of this bacterial flora shows that it contributes little to the well-being of man, being scanty in the digestive portions of the body, and abundant in other parts of the gut. Schottelius was the first to try the experiment of rearing chickens in a cage specially constructed to protect them from microbes. The chickens hatched out and lived for a few weeks ; there being no microbes within them and only sterilized food being given, instead of increasing in weight, they became thin and showed signs of starvation. Schottelius then supplied them with food from which bacteria were no longer excluded, upon which the chickens rallied and soon became completely restored to health. Madame Metchnikoff tried a similar experiment with tadpoles, which, when kept in vessels and fed upon bread containing the usual microbes, developed normally, but which, when reared under conditions entirely free from the presence of microbes, lived on for some months, but in a degenerate condition, their development being arrested.

On the other hand, Nuttall and Thierfelder succeeded

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which, fortunately, never occurs. Given such favourable conditions, fission of bacteria would occur about once every hour and, the increase being in geometrical ratio, the progeny of a single bacterium would in 2 days number 281,500,000,000 and the weight of the microbes in four days would equal thousands of tons.—C. M. B.

in keeping alive for several days new-born guinea-pigs, the alimentary canals of which were free from microbes, and which were fed only on absolutely sterilized milk and vegetable matter. Notwithstanding this complete absence of microbes the guinea-pigs developed well.

As the two sets of experiments were conducted under conditions arranged so carefully that the chance of error was excluded, it is important to try to reconcile the apparently contradictory results. There is one point common to these three experiments—*i.e.*, that they were all executed upon newly born creatures. Now, it is well known that at birth the digestive juices are often very imperfectly secreted. In the case of the guinea-pigs, these juices sufficed in quantity for the digestion of the diet provided, whereas in the cases of the chickens and the tadpoles, the digestive juices were incapable of fulfilling their function satisfactorily, and the introduction of microbes endowed with considerable digestive capacity into the intestines compensated for the functional inefficiency of the gastric juices. In addition to the guinea-pigs experimented upon by Nuttall and Thierfelder, there may be mentioned a whole series of lower creatures such as the larvæ of mites and other insects which are able to digest such indigestible material as wax and wool in spite of the total absence of microbes within their intestinal tubes. These experiments are corroborated by the established physiological fact that the gastric and pancreatic juices of mammals easily digest the most varied kinds of foods, even if treated so antiseptically as to ensure the total exclusion of microbes from the intestines.

Wounds of the abdomen are really serious only when they penetrate the intestines and so allow the entrance of bacteria from that region to the peritoneal cavity. In such an event, the microbes rapidly multiply in the

organism and produce a grave and frequently mortal illness. So long as the microbes remain within the intestines very few of them get into the circulation, and with these few the organism is able to cope. While most of the microbes are confined within the walls of the alimentary canal, the soluble excretions produced by them pass through into the lymph and blood. Quite a number of different facts establish this. Thus, for instance, it has been known for long that the urine of human beings and of animals contains a series of substances such as derivatives of phenol, indol, creosol, skatol, and so forth. In certain diseases the amount of these substances greatly increases. The stagnation of the contents of the intestines increases the amount of phenol and indol. Such facts and many others make it probable that these substances are the products of the bacterial flora of the intestines. They are absorbed by the intestinal wall, pass into the general circulation, and may give rise to various symptoms of a more or less serious nature.

Ignorant of death and of old age, mammals have acquired the advantages of a large intestine at the expense of longevity. I have already stated that birds live longer than mammals. Birds are practically devoid of a large intestine, and maintain a bacterial flora very much poorer than that found in mammals. There is one exception to this rule, an exception of great importance. Ostriches and their allies, the largest known birds, are characterized by absence of the power of flight and by rapidity of terrestrial locomotion by which they escape their enemies. These are the only birds in which the large intestine is well developed. The duration of life is much less in their case than in that of smaller birds, such as parrots, ravens, and swans. According to M. Rivière, who has been engaged in ostrich farming in Algeria, these large birds do not live more than thirty-

five years. The mode of life, and the shorter duration of life, the huge development of the large intestines, and the rich bacterial flora found therein make the ostriches much more like mammals than birds.

It is to be noticed that many birds in which the duration of life is long do not possess a cæcum, the portion of the alimentary canal that contains most bacteria. Examination of the intestinal contents of parrots shows that there exist in these birds very few microbes. A comparative study shows plainly that the existence of an abundant intestinal flora, useless for digestion, helps to shorten life by producing bacterial poisons which weaken the higher elements and strengthen the phagocytes.

The human race has inherited from its ancestors an enormous large intestine and conditions favourable to the life of bacteria. It has to endure the disadvantages of this heritage. On the other hand, the brain of man is very highly developed, and with the increase of intellectual power has come a consciousness of old age and death. Our strong will to live is opposed to the infirmities of age and the shortness of life. Here lies the greatest disharmony of the constitution of man.

If we desired to make the phenomena of old age physiological rather than pathological, it would be necessary to reduce the evils arising from the presence of a large intestine.

In the human intestines, under normal conditions, putrefaction occurs only very slightly, or does not occur at all. But in intestinal diseases of children and of adults, the microbes of putrefaction multiply abundantly and produce copious secretions which inflame the intestinal walls. To avoid these diseases of putrefaction in the case of infants, it has been suggested to use as food only sterilized milk or other foods quite free

from microbes. This regimen has proved extremely successful.

In the investigation of the factors that hinder putrefaction, it has been noticed that milk putrefies with considerable difficulty, whereas meat, preserved under the same conditions, decomposes very readily. Investigators have attributed the stability of milk to the presence of casein or of milk-sugar. Investigations have proved the existence of certain microbes that hinder the putrefaction of milk. These are in particular the microbes that sour milk—*i.e.*, cause the formation of lactic acid—and which are antagonistic to the microbes of putrefaction. The latter multiply only in an alkaline medium. The lactic acid microbes produce large quantities of acid and so hinder the multiplication of the organisms of putrefaction. Putrefaction takes place rapidly, in spite of the presence of the lactic acid microbes, if there be added soda to macerations of meat or to milk. Such facts explain how it is that lactic acid frequently stops some cases of diarrhœa, and why treatment with lactic acid is so useful in maladies associated with putrefaction of the intestinal contents. It makes intelligible, moreover, the medicinal value of fermented milk.

Rovighi, an Italian physician, drank daily a litre and a half of kephir, a preparation made by subjecting milk to lactic acid and alcoholic fermentations. He found that in a few days the products of intestinal putrefaction in his urine either disappeared or were greatly reduced.

It is plain, then, that the slow intoxications that weaken the resistance of the higher elements of the body and that strengthen the phagocytes may be arrested by the use of kephir, or still better of soured milk. The latter differs from kephir in that it contains no alcohol, and alcohol in course of time diminishes the vitality of some important cells in the body. The presence of a

number of the lactic acid bacteria is inimical to the growth of the bacteria of putrefaction, and so is of great service to the organism.

But it is not enough merely to introduce useful microbes into the body. We must also prevent the entrance of microbes which are harmful. Soil, especially when it has been manured, contains large numbers of microbes, some of which are noxious, such as the bacilli of tetanus.

Obviously we should eat no raw food, but confine our diet rigidly to food that has been thoroughly cooked or sterilized.[1] The exclusion of harmful microbes and the introduction of beneficial microbes, such as those of lactic acid fermentation, must be of great service to health.

Science, even in its present imperfect condition, has many weapons by which to prevent or at least diminish the slow and chronic poisoning of the organism that leads eventually to the degeneration of the higher elements. When these elements are being destroyed by syphilis or alcoholism the struggle must be directed against these evils.

By strengthening the resistance of the higher elements and transforming the harmful population of the intestine into a useful population, the pathological symptoms of old age may be removed and, in all probability, the duration of the life of man may be considerably increased.

If it be found impossible to eliminate all the harmful microbes from the flora of the intestines, those that are refractory may be rendered harmless by appropriate serums. We know already a serum that is specific against the microbe of botulism, an organism capable of exciting serious disturbance if it gain entrance to the alimentary canal.

[1] Modern medical science teaches that we should eat plenty of raw fruits and green food (lettuce, cresses, etc.), but insists that these be free of all harmful microbes.—C. M. B.

Our inmost convictions assure us that life is too short, and since the remotest ages attempts have been made to prolong it. One of the oldest methods in the world consisted in bringing old men in contact with the bodies of young girls. David, King of Israel, employed this method which at a much later period came into fashion.

Eighteenth-century quacks proclaimed a number of specifics, among which was the "holy water" of Saint Germain, an infusion of senna, merely purgative in its effects. It is certain that some of the medicines used for the purpose, by emptying the large intestine, decreased the bacterial flora, and so checked the formation of the poisons that are harmful to the higher elements.

I am convinced that a science of the prolongation of life could be built up. An exact investigation of the phenomena of old age would contribute to this object. At any rate, we cannot set aside as chimerical plans to make old age a natural process, and one easy to bear. I believe, moreover, that attempts to prolong life deserve to be encouraged, the more so as instances of longevity are already numerous.

Quite a number of cases of centenarians who have preserved intellect and vigour until death have been recorded. It is unnecessary to relate the histories of these persons, of whom some attained such ages as 120, 140, and even 185 years (Saint Mungo of Glasgow). My friend, Professor Ray Lankester,[1] thinks that such unusually old persons are monstrosities comparable with those who have attained a gigantic stature. But centenarians are more numerous than giants, and while the latter exhibit marked signs of pathological weakness the former surprise us by their health and vigour.

The longevity of the Israelites recorded in the Old Testament is well known. No doubt there is much

[1] *The Advancement of Science.*

exaggeration in these naïve records. Was it an error of exaggeration to impute an age of 969 years to Methusaleh, or of 595 to Noah, or were these ages reckoned on a different basis? Henseler suggested that in these cases each season was counted as a year, so that the age of Methusaleh was really only 242 years, a length of life not so vastly greater than ages recorded in modern times.

There is evidence to show that in somewhat later Biblical times ages were reckoned in our years. Thus in the Book of Numbers (i. 3, 20, 22) reference is made to those "From twenty years old and upward, all that are able to go forth to war in Israel." The limit of age given shows clearly that the years counted were our years. This interpretation is supported by many other passages in the Pentateuch, notably where annual harvest feasts are spoken of. We may therefore accept as probable the assignment of such ages as 100 or 120 years to several Biblical personages, such as Aaron, Moses, and Joshua. And the words put in the mouth of Jahveh may be accepted as important evidence: "And the Lord said, My spirit shall not always strive with man, for that he also is flesh: yet his days shall be an hundred and twenty years."[1] The longevity of that remote period must have surpassed the age of the present time.

Humanity would make a great stride towards longevity could it put an end to syphilis, which is one of the principal causes of arterial sclerosis. The suppression of alcoholism, the second great factor in the production of senile degeneration of the arteries, will produce a still more marked extension of the term of life. Scientific study of old age and of the means of modifying its pathological character will make life longer and happier. Although modern knowledge is still imperfect, there is no reason to be pessimistic on the subject of old age.

[1] Genesis vi. 3.

CHAPTER XIII

THE SCIENTIFIC STUDY OF DEATH

INSTEAD of retaining its existing melancholy and repulsive character, old age may become a healthy and endurable process, and the duration of life may be prolonged. However, it may be asked, what shall we gain by attaining the age of one hundred or one hundred and twenty years instead of seventy or eighty, if there still remain for us the appalling fate of annihilation. Marcus Aurelius said that he who makes a long journey and he who makes a short alike meet death at the end; and that, once over, three years or a century are much alike. Such assertions, however, do not take into account the difference in the values we set on a thing at different ages. A man of the age of twenty-five years and one fifty years old reason differently, and are affected differently by the same surroundings. The outlook on life changes in the same individual as he gets on in years. Young people judge of their impressions by comparison with their ideals, and, as the latter are very high, they are dissatisfied with things as they really are. They are exacting, and discontented with what they can get out of the real world; grown up people and those of advanced years are more easily satisfied because they have a clearer knowledge of the true value of things—in short, the young are more inclined to pessimism than the old. It has often been said that life is only a preparation for death. Cicero said, "From our youth upwards we must accustom ourselves to face our last moments without

fear. If not, there is an end to peace, since it is quite certain that we must die."

We are so accustomed to look upon death as something natural and inevitable that it has long since come to be regarded as inherent in organisms. However, when biologists investigated the matter more carefully, they failed to discover any proof of the accepted doctrine. Observation of members of the lowest grade of animal life, such as infusorians and other protozoa, has shown that these reproduce by simple division, and in a very short time multiply to an astonishing extent. Generation succeeds generation with the utmost rapidity and without the intervention of death; no single corpse appears in the swarming masses of animalculæ. From such facts, which are extremely easy to confirm, several biologists, notably Bütschli and Weismann, have deduced an immortality of the unicellular organisms. When an infusorian has divided, each daughter organism rapidly completes itself and sets about again dividing in the fashion of its parent. The process may be more complicated, as in the cases where a single organism breaks up into several portions each of which contains an essential part of the parent organism. Many unicellular organisms reproduce in such a fashion, and as each animal divides simultaneously into a number of individuals of the new generation, the individuality is destroyed.

It cannot be disputed that lower organisms are not subject to the natural death that comes inevitably to man and the higher animals.

The theory of the immortality of unicellular organisms is now generally accepted. However, there are animals higher in the scale of life to which natural death does not come. Among these occur certain forms of considerable complexity, composed of many organs and very many cells, such as many polyps, and some worms, especially

annelid worms. Some annelids (Fig. 14) reproduce by transverse divisions very actively. "Throughout the summer," said E. Perrier, "the Naïdimorpha are devoid of genital organs, and, according to Maupas, they may be kept alive for several years, and perhaps indefinitely, in this sexless condition." This certainly may be regarded as a case of immortality due to the indefinite power of regeneration possessed by a complex animal.

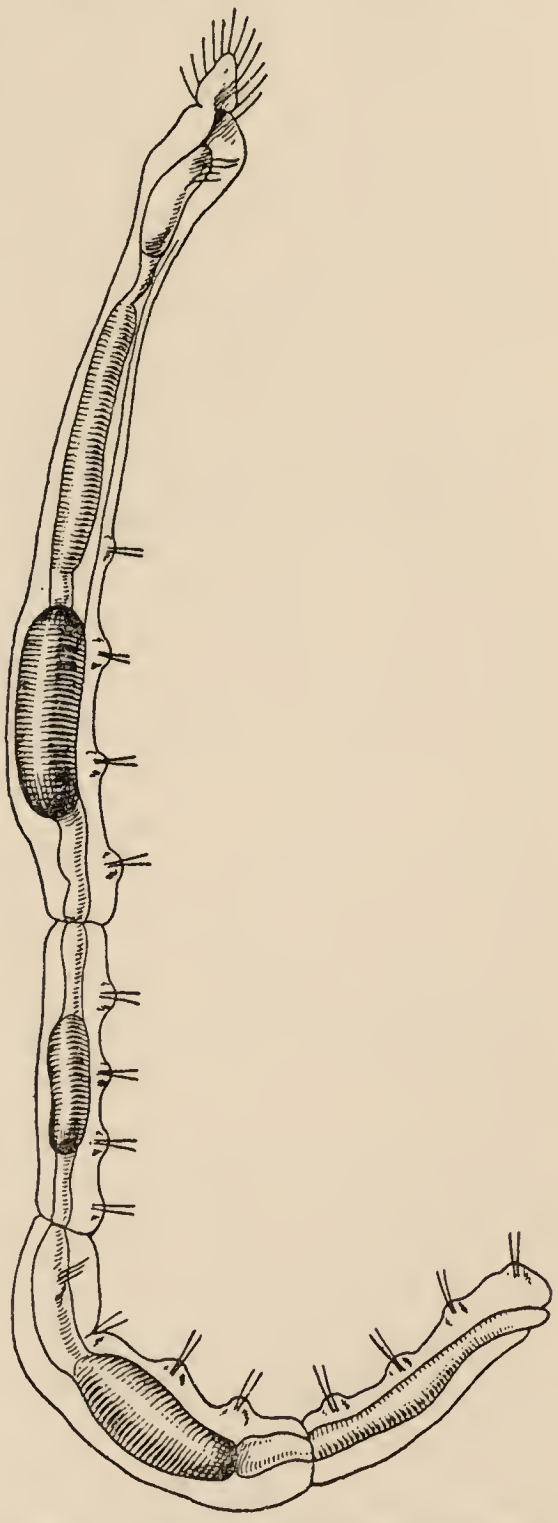

FIG. 14.—CHÆTOGASTER ABOUT TO DIVIDE.

The facts cited show that death is not necessarily inherent in living organisms.

The age of the famous dragon-tree of the Villa Orotava at Teneriffe was estimated at several thousand years. Its trunk was hollow, but the huge monster continued to flourish until it was overthrown by a storm. It was only by a catastrophe that the long-lived giant perished. The Baobab is reputed to live for five or six thousand years.

Jacques Loeb has observed that ripe but unfertilized eggs of sea-urchins die a few hours after they have been discharged. Loeb thinks that this may be a case of natural death, but I cannot agree with this opinion, as an egg that has not been fertilized by a spermatozoon may be compared with an organism deprived of its nutrition and so dying of starvation. In both cases death is purely accidental and could have been avoided.

If natural death does exist, it must have appeared on the face of the earth long after the appearance of life. Weismann has suggested that death arose as an adaptation for the advantage of the species—that is to say, in relation to the surrounding conditions of existence, and not as an absolute necessity inherent in the nature of the living substance. He thought that, as worn organisms are no longer suited for reproduction or for the struggle for life, natural death was due to natural selection, it being necessary to maintain the species in a vigorous state by weeding out the weaker individuals. But the introduction of death for that purpose was superfluous, since the debility caused by old age in itself would eliminate the aged in the course of the struggle for existence. Violent death must have appeared almost as soon as living things came into being. The infusorians and other low organisms, despite their potential immortality, must have been subjected perpetually to violent death, falling victims to larger and stronger organisms. It is impossible to regard natural death, if indeed it actually exists, as a product of natural selection for the benefit of the species. It could rarely come into operation, because maladies or the voracity of enemies so frequently cause violent death.

No doubt a certain number of deaths are recorded in statistics as being due to old age, without visible malady. Sometimes decrepit old men feel no pain and seem to fall

quietly into their eternal sleep; but autopsy reveals serious lesions of the internal organs. There is reason to believe that even such deaths are in reality violent and are usually caused by infectious microbes.

For some time natural death has been ascribed only to the parts of the body that are of use in the individual life. Those cells, the function of which is to secure reproduction of the species, are, like unicellular organisms, potentially immortal. The fertilized egg-cell of the female is transformed into a fœtus, and so is the starting-point of the new generation, while the sexual cells of the new generation give rise to the third generation, and so on, in an endless chain of life. The greater number, by far, of the eggs and spermatozoa perish; but their death is not natural but violent, being due to harmful external agencies. An infinitesimal minority of the sexual cells survive indefinitely in the successions of generations.

Scientific proof exists, therefore, that our bodies contain immortal elements—eggs or spermatozoa. As these cells not only are truly alive but exhibit properties that are within the category of psychical phenomena, it would be possible to build up a serious thesis on the immortality of the soul.

Observations on protozoa show that these simple beings, each of which is composed of no more than a single cell, possess a high degree of sensibility. They select their food, distinguish living from dead animalculæ, seek out their mates for conjugation, avoid danger, and hunt their prey; in fact, they are in possession of a set of qualities that must be included in psychical phenomena. Although such phenomena are very much simpler in their case than in the case of higher animals, it is possible to speak of the soul of protozoa. Moreover, as the body is immortal by reason of its indefinite power of reproduction

by division, the soul also of these creatures is immortal. However, the soul is so primitive that it is impossible to speak in definite terms about it.

As the sexual cells of the human body are immortal, like the protozoa, the problem arises if these too be endowed with an immortal soul. Our existing knowledge makes it impossible to doubt that ova and spermatozoa have sensibility in a degree as high as that of the protozoa. The ova shed secretions that arouse the sensibility of the spermatozoa, and the latter, directed by this specific "odour" or chemotaxis, make their way to the ovum and penetrate it. Some substances, arousing the spermatozoa into activity and movement, attract them, others repel them. The phenomena of chemotaxis were shown for the first time in the case of cryptogams by Pfeffer, the distinguished botanist, and since then the male cells of many plants and different kinds of animals have been proved to possess such sensibility.

When ova and spermatozoa succeed in conjugating, they produce an individual of the next generation, to which they transmit what Haeckel has called the "cell-soul." This soul, then, is really immortal, inasmuch as the bodies of the reproductive cells are immortal.

Although it is true that our bodies contain elements endowed with immortal souls, it by no means follows that our conscious souls are immortal. I have already pointed out that the psychical phenomena of many of the cells of our body and the cell-souls of these are outside our consciousness. We have no consciousness of the perpetual battle waged by the phagocytes against the microbes that endeavour to obtain a foothold in our tissues. None the less the phagocytes are elements endowed with mobility and sensibility and possessing a cell-soul like that of the protozoa.

A woman has no consciousness of the numerous

spermatozoa, with their cell-souls, that enter her body, nor of those that fertilize her egg-cells; she is even without consciousness of the much more highly developed soul of the fœtus. A child before birth possesses psychical qualities much more numerous and more perfect than those of the reproductive cells. It is capable of responding to certain sensations and of performing movements. A child, in the later months of its prenatal existence, possesses the senses of touch and taste and, within limits, the sense of sight. This soul is outside the consciousness of the mother. The mother cannot even tell by her consciousness if she bears under her girdle one or two embryonic souls. And so the immortality of the cell-soul has no relation to the problem of death.

It is a common opinion that only the reproductive cells of man and animals are immortal, and that the other elements of the body are mortal, the latter, if they escape violence, dying a natural death. A contrast has been drawn between the mortal cells in which is resident the life of the body and the immortal cells on which the species depends. However, when non-reproductive cells possess the power of regeneration, it is impossible to deny their immortality. When a polyp or a worm reproduces by division, a large number of cells go to form the new individual, and these cells are immortal in the fashion of the infusoria.

Immortal animals occur only among the lower invertebrates. The power of regeneration fades away in the higher ranks of the scale of life. While worms may be divided in several pieces, each piece being capable of regeneration so as to form a new worm, when molluscs are cut they display only a limited capacity for regeneration. If the antennæ of a snail be amputated they will be renewed, but if the whole creature be cut in pieces

death follows. Some of the lower vertebrates, such as newts and salamanders, can renew the tail and the limbs, but they cannot reproduce by division. Birds and mammals, the higher vertebrates, have very little power of regeneration, and tail and limbs are never re-formed in these cases.

It seems to be the case that the advance in the general

FIG. 15.—EPHEMERIDS.

organization of animals has involved a loss in the reproductive capacity of the cells and tissues. Even in the highest animals some organs, such as the skin, still possess regenerative capacity; but, on the other hand, many cells have lost the power of regeneration completely. The nervous cells, in particular, which are the highest and most perfectly organized elements of the body, cannot reproduce themselves. After their initial appear-

ance in the course of embryonic development, they pass their lives without regenerating or reproducing. In acquiring the highest qualities—that is to say, their psychical activity—they have lost completely the power of reproduction, the distinctive feature of immortal cells. If cells doomed to natural death really exist, it is in the nervous tissues that we must look for them.

The existence of natural death in the animal world cannot be denied, but it is very rare. The best example is that of the curious insects known universally as ephemerids or may-flies (Fig. 15). Swarms of these delicate and graceful insects are to be seen round lights in the summer months. The perfect insects emerge from water, in which the six-legged larvæ feed on the organic débris contained in fresh water. The larvæ are not predacious, and escape from their numerous and hungry foes by agility. They are long-lived—some of them passing two or three years in the mud of streams—and in the end become winged insects after a rapid metamorphosis. Near Paris, one species (*Palingenia virgo*) emerges in swarms after sundown from the waters of the Seine and Marne. The flight of these insects lasts only an hour or two, and then, in an enfeebled condition, they fall down in vast numbers (Fig. 16). They are attracted by the lanterns lighted by fishermen, and are collected for bait. The life in the winged condition is truly ephemeral and lasts no more than a few hours. The structure of the insect is adapted to this short life. The larvæ have powerful jaws, used in the mastication of food; the winged insects possess only vestiges of jaws. They are unable to feed, and so are adapted only for the briefest existence. Their hour of aerial life is devoted to love. As soon as they emerge the males and females unite, and the packets of eggs, which are deposited at once, fall into the water, and in a few weeks the young larvæ hatch out.

FIG. 16.—SWARMS OF PALINGENIA VIRGO.

The mode of life and the organization of the adult ephemerids show plainly that they are adapted to natural death. Death comes to them, not because they are without food or because the environment fails to provide something necessary to life, but merely because they emerge from the larval state in a non-viable condition, without the organs necessary to the maintenance of life.

Once it is granted that natural death actually exists, it is necessary to study its mechanism as closely as the existing state of knowledge permits. To exclude the possibility of the death having to be interpreted as violent, it would be necessary to know that some very rapid infectious disease does not attack these insects as soon as they emerge from the water. This possibility, although remote, must be examined. Instances are known of large numbers of insects dying very rapidly as the result of attack by a species of mould which causes an epidemic. Every one has seen, especially in autumn, dead flies anchored to the window-pane by a little tuft of white fluff. As so many individuals die about the same time, we might be disposed to assign the fact to natural death. The actual cause, however, is an infectious and fatal disease caused by a parasitic mould.

The occurrence of some epidemic may be excluded from consideration in the case of ephemerids. I have made investigations which show that such an epidemic does not occur. The bodies of the dying ephemerids contain no microbe which could be the cause of death. Their death must be regarded as natural, as essentially a part of the nature of the insects. Among the cells of their body there are many active phagocytes. Is it possible to attribute death to ravages that these cells cause among the higher cells and tissues? Microscopic examination, so far from supporting such a possibility, shows that the organs are quite normal. The brain and

central nervous system, the muscles and other organs, show no signs of that invasion by phagocytes found in cases of senile degeneration. In this example of natural death there is certainly no possibility of phagocytic intervention.

Some biologists have suggested that the rapid death of ephemerids and of some other insects is due to debility caused by the great effort of depositing the male and female sexual cells. On this supposition, the case would be analogous to the shock which is sometimes the consequence of a surgical operation. This hypothesis, however, may be excluded, for among the dead ephemerids there are many males that have not united with females. Among ephemerids males are much more numerous than females; many males have no opportunity of undergoing the sexual shock and of emptying the reproductive organs, and these, none the less, die as rapidly as the others.

As yet we do not know if all the tissues of the ephemerids die simultaneously in natural death. Most probably the cells of the nervous centres perish first, and so bring death on the others. The investigation ought to be made.

Death comes to the ephemerids in the midst of love, at the moment when their sexual instincts are satisfied. It would be very interesting to know the sensations of these creatures as they feel death come on them in the act of reproduction. Naturally it would be impossible to obtain a full answer to the question, but many interesting facts regarding it may be ascertained. All the ephemerids, not only those the life of which is so brief, but those that live for several days (*Chloë*, for instance), are extremely easy to capture. It is unnecessary to take them unawares or to use a net as in the case of flies, wasps, and many other insects. Ephemerids may

be taken with the fingers in the simplest way, because they offer no resistance and show no desire to escape, although they have six legs and two or four wings. This is not an isolated case, for some other insects (as, for example, winged ants and aphides) allow themselves to be captured with the same indifference.

Although the adult ephemerids are indifferent, the wingless larvæ are timid. When a tube is brought near them, among the water plants, with the object of capturing them, they rapidly move off. It often requires much patience and quickness to capture these larvæ (Fig. 17). The instinct of preservation of life displays itself by rapid flight.

Fig. 17.—Larva of an Ephemerid (Chloë rufulum).

It is remarkable that the adult insect has lost the instinct of self-preservation. If it be touched it may move a short distance off, but it does not take to flight although its wings are very large, and its body, which of itself weighs little, is still lighter because the digestive tube is filled with air and not with food. As a rule, an ephemerid that has been touched does not even move off, but allows itself to be captured without any resistance. It would not be accurate to say that the larva's instinct of self-preservation has been replaced in the adult by an instinct for death; but it must be admitted that the instinct of preservation has been totally lost. The lack of resistance cannot be explained by any defect in the organs of sense. Not only are the eyes of the larval stage fully preserved in the adult, but the adult males have enormous eyes to enable them to recognize the female in the turbulent flight which takes place at the close of the day. Ephemerids of all ages possess well developed tactile

organs, and it is thus in spite of a highly organized sensory system that the adults offer no resistance to enemies.

It is no mere accident that the most striking examples of natural death occur among insects, for these creatures display an unusual stability in their cellular structure with a corresponding lack of the power of regeneration—in these particulars resembling man and the higher animals. The cells of the nervous system are very complex, and are well adapted for the highest function—that is to say, the psychical function. These highly endowed cells, however, are devoid of the power of reproduction. Many experiments have been made in relation to this, and it has been proved clearly that in cold-blooded vertebrates the nerve cells of the brain and spinal cord are capable of regeneration, while among mammals only extremely rare cases are known in which there has been any regeneration of the nervous elements. It is to be expected, then, that cases of natural death occur in the higher animals and especially in man. However, no case so well illustrates this as that of the ephemerids. Of deaths apparently due to senile debility in man, a large proportion are certainly due to various infectious diseases that affect the old, such as pneumonia and nephritis. Close examination of the tissues confirms this conclusion, for the destruction of the higher elements by phagocytes produces what is really violent death and not a natural death like that of the ephemerids.

Natural death in man is probably a possibility rather than an actual occurrence. However, natural death may occasionally occur in very old men.

Attempts have been made to estimate the natural limits of human life. Flourens based a calculation on the duration of the period of growth. If the latter be taken as one fifth the natural life, then human life

ought to last a century. As centenarians are rare the vast majority of deaths, which happen before that age has been reached, must be regarded as violent or accidental. The rule of Flourens, however, is arbitrary, and there is no evidence to show that it is exact. Probably in the human race, as in the case of ephemerids, the natural duration of life varies and cannot be expressed by a definite figure. In most cases it ought to be more than a hundred years, and only in rare cases ought it to be much less than that term. Probably there is a variation in the duration of life just as there is a variation of the date of sexual maturity.

The existing pathological character of old age vitiates all conclusions as to natural death, and it is still impossible to be exact in speaking of that subject. It is known that certain organs and tissues remain alive for some time after death. In certain cases of disease, the heart has been removed from a human body more than thirty hours after death, and when placed under proper conditions renewed its life, and beat for several hours. The white corpuscles, the spermatozoa, and the ciliated cells of a corpse may retain their power of movement. Does this also happen in the rare cases of natural death? That question must be answered in the future. The most important question relating to natural death is the following: Is the appearance of natural death in man accompanied by the disappearance of one instinct, the instinct of self-preservation, and by the appearance of another instinct, the instinct of death? Do the phenomena of the ephemerids give us any indication as to this? An exact answer is not to be expected. As old age is generally what may be called an unnatural phenomenon, it is extremely rare for persons to approach the age of natural death with their faculties unclouded. I have had under observation a centenarian who still

remembered some incidents of her youth; in her the desire to live was still strong, but her intellectual faculties were partially dimmed. Her brain, after death, showed marked degeneration of the nerve cells due to the activity of macrophags.

Tokarski, writing on the fear of death, quoted the case of a female centenarian who stated as follows: "If you come to live as long as I have lived, you will understand not only that it is possible not to fear death, but to feel the same need for death as for sleep." A new feeling had come into existence in this very old person, a feeling incomprehensible to those less old. Apparently this was a case in which the instinct of natural death had appeared in a centenarian whose mental faculties had been retained in a sufficiently perfect state.

I wish very much that I had myself been a witness of this old woman's remarkable instinct, for all the cases that have been pointed out to me as subject to this new desire have turned out to have been possessed of very different ideas. Some were old invalids, weary of pain and ready to exchange the sorrows of life for death, but who would have preferred to be healed and to live on in comfort. When the possibility of recovering health was suggested to them, they showed signs of pleasure and of the renewal of hope.

Investigations that I have made in homes for the aged have led to negative results on this subject. No case showed the slightest sign of the instinct of death. However, I have learned from Dr. Fauvel of one case to add to the instance noticed by Tokarski. It was the case of an old lady whose health and circumstances were comfortable and who before her death showed a real desire for it, and stated so in much the same language as that quoted by Tokarski. In Fauvel's case, however, the old lady had reached the age of only eighty-five years.

It seems probable that this was a second genuine case of the appearance of the instinct of death, and it is therefore interesting to notice that that instinct, like the sexual instinct, is subject to variation in the date of its appearance.

The Bible testifies to the frequency of old age in ancient times and to the complete preservation of the faculties in the aged. It also contains some references that may be interpreted as instances of the instinct of death. I may take its account of the death of some of the patriarchs :—

"And these are the days of the years of Abraham's life which he lived, an hundred threescore and fifteen years. Then Abraham gave up the ghost, and died in a good old age, an old man, and *full of years*. . . . And the days of Isaac were an hundred and fourscore years. And Isaac gave up the ghost, and died, and was gathered unto his people, being old and *full of days*. . . . After this lived Job an hundred and forty years, and saw his sons, and his sons' sons, even four generations. So Job died, being old and *full of days*." [1]

It is probable that the phrase "old and full of days," which sounds strange in our ears, simply refers to the instinct of death, developed in well-preserved old men who had attained ages of from 140 to 180 years.[2] The Biblical phrase is not merely a commonplace phrase applied to the death of celebrities, for the references to deaths of other persons were put in different language. "And these are the years of the life of Ishmael, an hundred and thirty and seven years : and he gave up the ghost and died; and was gathered unto his people." [3] "And Jacob lived in the land of Egypt seventeen years : so the whole age of Jacob was an hundred forty and seven

[1] Genesis xxv. 7, 8; xxxv. 28, 29. Job xlii. 16, 17.

[2] It may be that the great longevity of many of the patriarchs, ending in the appearance of the instinct of death, is the cause of the small extent to which the idea of a future life had been developed amongst the ancient Hebrews. (See chap. IX.)

[3] Genesis xxv. 17.

years."[1] "And Aaron was an hundred and twenty and three years old when he died in Mount Hor."[2] "And Moses was an hundred and twenty years old when he died; his eye was not dim, nor his natural force abated."[3] In only one of these later cases had the individual reached the age of 140 years, at which age, apparently, the instinct of natural death appeared.

It may seem altogether surprising and improbable to us that an instinct for death should arise in man, since we are imbued with an instinct of an opposite nature. It is to be inferred plainly that the desire of life and the fear of death are manifestations of an instinct deep-rooted in the constitution of man. That instinct is of the same order as the instincts of hunger and thirst, of the need of sleep, of movement, and of sexual and maternal love. The devotion and care bestowed on their young by female birds and mammals are known universally. And yet these instincts can be reversed. There is no sacrifice of which the mothers are not capable if it serve to save the life or promote the well-being of their offspring. Such devotion is a manifestation of the maternal instinct, which is one of the strongest instincts known to us. And yet that love, so tender and so absolute, lasts only for the time during which the wants of the young need to be satisfied. As soon as the young begin to be independent, the maternal love changes to indifference or to dislike. At the next breeding-period, maternal love reappears again, so that there is a periodic ebb and flow of the instinct.

The new-born babe takes an instinctive delight in the milk of his mother, which seems to him the only good food in the world. As soon as he can show his feelings,

[1] Genesis xlvii. 28.
[2] Numbers xxxiii. 39.
[3] Deuteronomy xxxiv. 7.

his intense satisfaction as he is suckled is plain. But this instinct lasts only during the period of lactation. As soon as the child begins to take different kinds of food, he ceases to be pleased with his mother's milk, and may dislike it for the remainder of his life. Several adults to whom I have offered human milk would not even taste it, so disgusting did it seem to them. And yet the taste has nothing intrinsically disagreeable in it. Here again is an example of a strong instinct that changes completely.

Children often eat to repletion of some kind of substance, and for long afterwards that substance disgusts them instead of being coveted by them. It is said that apprentices to pastry-cooks and makers of sweetmeats are allowed at first to eat as much as they please. They soon come to have a profound dislike for the sweet things that children like so much.

Human beings full of the desire for life believe more easily in eternal life than in the possibility of an instinct of death. And yet the instinct of death seems to lie, in some potential form, deep in the constitution of man. If the cycle of human life followed its ideal course according to physiological function, then the instinct of death would appear in its time, after a normal life and an old age healthy and prolonged.

In reality, human life is subject from its very beginning to the pernicious disharmonies in the constitution of man. This evil influence increases with the passing of the years and leads to an old age ruined by abnormalities. It is not surprising that under such circumstances men wish neither to grow old nor to die. Old men, in spite of their attachment to life, do not attain the capacity to know all that is good in it, and die, in the fear of death, without having known the instinct of death. They may be compared with unhappy women who have married before their sexual instincts have awakened and who have

died in childbirth, without ever having known the real joy of loving. Formerly, the number of women in such a case was large. In some parts of Abyssinia, girls married when they were still very young and before their physical development was mature. According to Hassenstein, nearly one third of these young women died in childbirth. They quitted life before they had known the true sexual instinct. The advancement of civilization and of medical knowledge has greatly reduced the number of such unhappy women. We must hope that the progress of knowledge will bring about a similar advance in relation to the instinct of death. With that progress, the number of men who will live until the instinct has been attained will become greater and greater.

CHAPTER XIV

SUMMARY AND CONCLUSIONS

MAN, who is a descendant of some ape-like creature, has inherited a constitution adapted to an environment very different from that which now surrounds him. Man is possessed of a brain much more highly developed than that of his ape-like ancestors, and has entered on a new path in evolution. The sudden change in his natural conditions has brought about a large series of organic disharmonies which become more and more acutely felt as his intelligence and sensitivity increase. The disharmonies in the sexual functions have brought into existence attempted remedies of the strangest kind. The greatest disharmony of the constitution is that of the morbid nature of old age and the impossibility of reaching the instinct of natural death; this has produced childish and erroneous conceptions of the immortality of the soul and of the resurrection of the body, and many other strange doctrines that have been imposed upon us as divinely-revealed truths.

Human intelligence, in the course of its progressive evolution, has rebelled against these naïve palliatives. Finding the restoration of the much-desired harmony beyond its power, humanity became resigned to a passive fatalism, and believed even that the existence of man was a kind of bad joke, a *faux pas* in the evolution of sentient organisms. Moving step by step, passing from the simple to the complex and from the particular to the general, science has established a set of truths which all the world must accept.

Humanity in its misery has put question after question to science, and has lost patience at the slowness of the advance of knowledge. It has declared that the answers already found by science are futile and of little interest. From time to time it has preferred to turn back, and to delude itself with the beautiful mirages offered by religions and systems of philosophy.

But science, confident of its methods, has quietly continued to work. Little by little, the answers to some of the questions that have been set have begun to appear. Whence do we come? science has been asked unceasingly. Is not man a being unlike other beings, made in the image of God, animated with the divine breath, and immortal? No, science answers. Man is a kind of sport of an ape-like animal, and endowed with profound intelligence and capable of great progress. His brain is the seat of very complex processes and is more highly developed than that of other animals, but its functioning is incompatible with the existence of an immortal soul.

Whither are we going? That question above all other things has absorbed the attention of man, and naturally so, for it is less important to know our origin than to know our destiny. Does death mean absolute extinction, or is it a gateway leading to a new and everlasting life? And, if the latter alternative be untrue, how are we to face inevitable death?

Science cannot admit the immortality of the conscious soul, for consciousness is a function of special elements in the body that certainly do not live for ever. Immortality exists only for those low organisms that renew their lives by repeated divisions with complete regeneration, and that have no highly developed consciousness.

Death brings absolute extinction, and it seems unbearable because of the condition in which it surprises us. It comes before man has finished his physiological

development, and when the instinct of life is still strong.

Ever since man has begun to look a little beyond his daily and immediate wants, he has asked if there be a goal for his life, and what that goal may be. As he has generally failed to find such a goal, he has gone the length of believing life to be a mere accident, and of thinking it idle to seek a goal. He has formed depressing and pessimistic conclusions. Humanity may be compared to a boy who has not yet acquired the sexual instinct, but has asked the meaning of the reproductive organs. As these organs play no part in the functions of his life, he might easily think their existence not only absolutely useless but absurd.

Man, because of the fundamental disharmonies in his constitution, does not develop normally. The earlier phases of his development are passed through with little trouble; but, after maturity, greater or lesser abnormality begins, and ends in old age and death that are premature and pathological. Is not the goal of existence the accomplishment of a complete and physiological cycle, in which occurs a normal old age ending in the loss of the instinct of life and the appearance of the instinct of death?

The normal end, coming after the appearance of the instinct of death, may truly be regarded as the ultimate goal of human existence. But, before attaining it, a normal life must be lived : a life filled all through with the feeling that comes from the accomplishment of function. Knowledge of the true goal of life clears up the problem and shows us the right conduct of life. Religions and systems of philosophy which have tried to find another foundation for morality have regarded human nature as vicious at the roots. Science has been able to tell us that man, the descendant of animals, has

good and evil qualities in his nature, and that his life is made unhappy by the evil qualities. But the constitution of man is not immutable, and perhaps it may be changed for the better.

Morality should not be based on human nature in its existing vitiated condition, but on human nature, ideal, as it may be in the future. Before all things, it is necessary to try to amend the evolution of the human life—that is to say, to transform its disharmonies into harmonies (*Orthobiosis*). This task can be undertaken only by science, and to science the opportunity of accomplishing it must be given. However, even in the most civilized countries, science is far from being in this ideal condition. Obstacles lie in its way and retard its advance.

To make the human constitution better, it would be necessary to know it thoroughly. How can we try to transform to a normal and physiological condition old age, at present utterly pathological, unless we first understand the most intimate details of its mechanism?

As soon as we come to believe that the solution of the problems of human happiness will come not from religions nor from systems of metaphysical philosophy, but from exact science alone, the obstacles to progress will be removed. The study of the human constitution not only denotes the real goal of our existence, but also indicates to us what is meant by true culture and real progress.

Herbert Spencer examined the phenomena that he regarded as progressive, first in the inorganic world, next in the world of living things, and finally in humanity. He regarded as progressive only the changes that tend to increase human happiness. In order to define progressive phenomena Spencer made parallel studies of them in man and the animal world. He found

that progress is marked always by a transformation from the simple and uniform to the complex; and that it produces constant differentiation, in the evolution of the planetary world, in the embryonic development of the individual, and in the societies of men and animals. But differentiation is not a complete account of progress, for in the latter must be included the change of the indefinite into the definite. Spencer identified progress with evolution, and his well-known definition of evolution is that it is "an integration of matter and concomitant dissipation of motion; during which the matter passes from an indefinite, incoherent homogeneity to a definite, coherent heterogeneity; and during which the retained motion undergoes a parallel transformation." Such a formula embraces too much, especially when applied to human affairs. Differentiation in itself is not the whole of progress. It is necessary in each concrete case to inquire into its limits and modifications.

The application of his theory of progress and evolution led Spencer, in his investigation of the basis of morality, to define human progress as the tendency towards a life as full and as long as possible. Civilized life as compared with savage life is a realization of progress. Civilized man, according to Spencer, uses food in a better regulated fashion, in accordance with the call and degree of his appetite; the food is of better quality, it is freed from contamination, is much more varied, and is better prepared. The same differentiation distinguishes the clothing, the homes, and so forth of civilized man. According to Spencer, all such progress helps real happiness—that is to say, the fulness and the prolongation of life.

It is easy to see, however, that such an interpretation of progress is inexact, like the conception of the goal of life associated with it. If the complication of the

mode of life, which is so marked in modern civilization, is really the best way of reaching happiness, there are no reasons to arrest the tendency in that direction. If, on the other hand, my view be correct, that true progress consists in the elimination of the disharmonies of human nature and in the cultivation of physiological old age followed by natural death, the conditions for realizing progress would be different and very clear. The great complexity of life in modern civilization is a sign of progress according to Spencer, but I do not agree with him. Spencer speaks of the variety and preparation of food. It is certain that this complexity militates against physiological old age, and that the simpler food of uncivilized races is better. Most of the delicate dishes provided in the homes, hotels, and restaurants of the rich stimulate the organs of digestion and secretion in a harmful way. One of the conditions that enabled the Jews of the earlier Biblical times to live longer than civilized people was, beyond all doubt, the greater simplicity of their diet. True hygiene, which is in open disagreement with the elaborated art of cookery, is also opposed to the differentiation of modern dress and dwellings. Progress thus would consist in simplifying many sides of the lives of civilized people.

The luxury which has done so much harm to mankind, and which would be included in the formula, "passage from indefinite homogeneity to definite heterogeneity," is founded not on a general law of evolution of the whole universe, but on a particular conception of life, quite different from mine, according to which the rectifying of the abnormal human cycle to a normal cycle is the true goal of life.

Perhaps one of the oldest conceptions of life that has tended to luxury is to be found in the book of Ecclesiastes. Having reached the conclusion: "For in much wisdom

is much grief: and he that increaseth knowledge increaseth sorrow" (i. 18), and having said: "Then I beheld all the work of God, that a man cannot find out the work that is done under the sun: because though a man labour to seek it out, yet he shall not find it, yea farther; though a wise man think to know it, yet shall he not be able to find it."[1] Solomon laid down the rules of life as follows:—

"Go thy way, eat thy bread with joy, and drink thy wine with a merry heart: for God now accepteth thy works. . . .

Let thy garments be always white; and let thy head lack no ointment. . . . Live joyfully with the wife whom thou lovest all the days of the life of thy vanity, which he hath given thee under the sun, all the days of thy vanity; for that is thy portion in this life, and in thy labour which thou takest under the sun. . . .

Whatsoever thy hand findest to do, do it with thy might; for there is no work, nor device, nor knowledge, nor wisdom, in the grave, whither thou goest."[2]

The wisdom of Solomon was to enjoy this life as much as possible, since man is unable to solve the problem of the goal of life. His precepts have been taken as a guide, and have led to an organization of life that could become only more and more epicurean.

As soon as the goal of life has been seen clearly, luxury ceases to be true happiness as it hinders the making perfect of the normal cycle of human life. Young people, instead of abandoning themselves to pleasure because they have nothing before them but a sad prospect of morbid old age and death, ought to make ready for physiological old age and natural death. As the body of knowledge grows greater, the time to acquire it will become prolonged, but this period of preparation will serve as the prelude to ripe maturity and ideal old age.

Old age is repulsive at present because it is an old age

[1] Ecclesiastes, viii. 17.
[2] Ecclesiastes, ix. 7–10.

devoid of its true meaning, full of egoism, narrowness of view, incapacity and malignancy. The physiological old age of the future assuredly will be very different. In the societies of animals, especially as they occur among insects, the members show a high degree of differentiation. Some individuals are adapted to the reproductive functions, while others are sterile and are fitted for the care of the young and to supply the wants of the community. This differentiation, which is of social value, has arisen independently in different groups. Thus, in the societies of bees and ants the workers are sterile females, while in the case of termites individuals of both sexes may be sterile. In the human race, evolution is following another path. There is no sign of the appearance of a sterile class; but, as the life of man is longer than that of insects, it is divided into two periods, a reproductive period and a sterile period. Old age, at present practically a useless burden on the community, will become a period of work valuable to the community. As the old man will no longer be subject to loss of memory or to intellectual weakness, he will be able to apply his great experience to the most complicated and the most delicate parts of the social life.

Young men are usually very bad politicians, and in countries where they take a large share in public affairs they do much harm because they are without the necessary practical knowledge. Their incapacity is clearly shown by the great changes in their political views as they advance in years and gain experience. In the future, old men will have charge of all complex and difficult social functions. Thus vast improvements will be made in politics and in justice, which at present are defective because of their insufficient foundations.

As soon as every one has recognized the true goal of

human life, and has assumed, as the ideal, the realization of the normal cycle of life, a real guide to life will have been found. We shall know at least whither we are going, and as yet we are ignorant of that. We have wished to make life better, but we have not known how or for whom to make the attempt. Formerly it was assumed that, in the future, love would spread and become generalized. Family love had spread to the tribe and then had been transformed to patriotism; it was held that no obstacle stood in the way of its embracing all humanity. Such an idea was prevalent in the eighteenth century, and became a common ground of all systems of philosophy, morality, and politics. But, since means of communication have been improved so vastly and since the most distant voyages are within the power of almost every one, the vague notion of "humanity" has been replaced by exact knowledge of the native savages in many parts of the earth.

Ostwald, the distinguished German chemist, calls good "the actions that made easier the existence of other men." But to what other men are we to apply this rule?

"What is the size of the circle of altruistic love?" asked Ostwald. "The general feeling," he said, "is that it should cover the family and the nation. The feeling that it should cover all humanity appears to most of us as a theoretical demand rather than something practical. And thus have not most of us the tendency to limit our altruistic actions much more in the case of men beneath us than in the case of our social comrades?"

Here we have entered on a problem relating to the principles of normal life. In former times, religion was the chief bond among men. Later on, religion gave way to patriotism, which in default of anything better still holds its place. Community of language unites the individuals of a nation, but the advance of civilization has undermined the foundation of that source of

differentiation. Naturally, when a number of men spoke only one and the same language, great solidarity was the result, as ideas spread only by language. But such a monoglottism is not the end of human progress. As means of communication have improved, the nations have been brought in contact with each other. The knowledge of foreign languages is an elementary necessity of modern life. And so the bonds of nationality will certainly become looser, in this respect following the bonds of family. The dislike that we have for people whose language we do not understand becomes changed into a feeling of unity with them as soon as we can understand them. In that respect an active development is in progress, and we shall have to seek out some new principle on which to base international solidarity. A good deal has been made of the possession by different nations of the same culture, but the vagueness of the phrase has not been realized. Recognition of the true goal of life and of science as the only means by which that goal may be attained would form an ideal on which men might unite; they would group themselves around that, as in former days men were held together by religion.

I think it extremely probable that the scientific study of old age and of death will bring about great modifications in the course of the last period of life. All that we know on these subjects confirms my view. But will it lead to the development of an instinct of death? That instinct lies deep in the roots of the human constitution. Will the means be found to bring it to the surface? Has not the enormous period during which it has remained latent led to its atrophy? The science of the future alone can answer these questions. But the persistence of organs and structures that are extremely ancient, as, for instance, the survival of the mammary

glands in males and of the vermiform appendix in anthropoid apes and man, gives us the hope that the instinct of natural death may emerge from its latent condition when old age has become a normal process.

The mammary glands of males are functionless rudiments. They must be interpreted as vestiges of organs that were more highly developed in remote ancestors among whom both sexes gave milk to nourish the young. This function exists in a latent condition in the males of living mammals. Extremely rare cases have existed in which males possessed large glands secreting enough milk to feed the young. These males, it is true, had the genital organs either very badly developed or in a condition approaching hermaphroditism. But in other authentic cases perfectly developed he-goats and rams have been known to provide milk in considerable quantities, while married men have suckled children with milk secreted by unusually developed glands. It is stated that the secretion of milk can be excited by stimulation of the nipples. Such examples of the reappearance of a latent property that has been lost for untold ages are extremely important.

Probably actual cases of the instinct of natural death in man are as rare as instances of the secretion of milk by males. But favouring circumstances would probably reawaken it and develop it fully. There is much work to be done before so great an object can be achieved. But it is the peculiar feature of science to be eager for much labour, while religion and metaphysics are content with passive fatalism and silent resignation. The mere hope of being able to solve the great problems of humanity in the more or less distant future brings much satisfaction. The point of view that I have exposed in this book will make life more possible. Our generation has no chance of attaining physiological old age and

normal death; but it may take real consolation from the thought that those who are now young may advance several steps in that direction. It may reflect that each succeeding generation will get closer and closer to the solution and that true happiness one day will be reached by mankind.

The slow advance to happiness will demand many sacrifices. Already men of science sacrifice their health and sometimes their life to reach the solution of some important problem to save the lives of their fellows.

Before it is possible to reach the goal, mankind must be persuaded that science is all-powerful and that the deeply rooted existing superstitions are pernicious. It will be necessary to reform many customs and many institutions that now seem to rest on enduring foundations. The abandonment of much that is habitual and a revolution in the mode of education will require long and painful effort.

Definition of the goal of human existence will bring great precision to the principles of morality. In the old days anyone was allowed to practise medicine, because there was no medical science and nothing was exact. Even at the present time, among less civilized people, any old woman is allowed to be a midwife. In some cases the mother attends the labour of her daughter, or (as for instance in a caste of natives in Malabar) it may be the mother-in-law who does the duty. Very often friends act as midwives. Among more civilized races differentiation has taken place, and childbirths are attended by women of special training, who are midwives by diploma. In the case of nations still more civilized, the trained midwives are directed by obstetric physicians who have specialized in the conducting of labour. This

high degree of differentiation has arisen with, and has itself aided, the progress of obstetric knowledge.

The politics of to-day are in the condition in which medicine was in days long past. True politics will have to be reared on new foundations. Every adult male is thought fit for exercising functions as difficult as those of an elector or a juryman. The only excuse for this condition is that political science is in its infancy. When sociology is more advanced there will come about a differentiation like that in medicine. When that has taken place, old persons who have acquired great experience, and who because of their physiological constitutions have preserved all their faculties, will give most valuable services to the society of the future.

In the progress towards the real goal of life, men will lose much of their liberty, but will receive in exchange a new feeling of solidarity. As knowledge becomes more and more extensive and exact, freedom to neglect it will be more and more limited. Formerly any one was at liberty to teach that whales were fish; but, now that it has been proved that whales are mammals, the mistake is not to be pardoned. Since medicine has become more of an exact science, the liberty of doctors has been restrained. Practitioners have already been sentenced for neglecting antisepsis and asepsis. Other forms of freedom, such as the freedom to neglect vaccination against smallpox, or to spit on the floor or in public places, are worthy of savage days and will cease as civilization advances.

On the other hand, the knowledge that the goal of human life can be attained only by the development of a high degree of solidarity among men will restrain actual egotism. The mere fact that the enjoyment of life according to the precepts of Solomon is opposed to

the goal of human life will lessen luxury and the evil that comes from luxury. Conviction that science alone is able to redress the disharmonies of the human constitution will lead directly to the improvement of education and to the solidarity of mankind.

In progress towards the goal, nature will have to be consulted continuously. Already, in the case of the ephemerids, nature has produced a complete cycle of normal life ending in natural death. In the problem of his own fate, man must not be content with the gifts of nature; he must direct them by his own efforts. Just as he has been able to modify the nature of animals and plants, man must attempt to modify his own constitution, so as to readjust its disharmonies.

Breeders form a conception of the ideal result when they are about to attempt the production of some new variety which shall be pleasing æsthetically and of service to man. Next they study the existing individual variations in animals and plants on which they wish to work, and from which they select with the minutest care. The ideal result must have some relation to the constitution of the organisms selected.

To modify the human constitution it will be necessary first to frame the ideal, and thereafter to set to work with all the resources of science.

If there can be formed an ideal able to unite men in a kind of religion of the future, this ideal must be founded on scientific principles. And if it be true, as has been asserted so often, that man can live by faith alone, the faith must be in the power of science.

APPENDICES

I

(p. 11, line 6)

WILL man some day meet the fate which, according to the irrefutable evidence of geology, has been that of so many other species from the Trilobites to the Mastodons? The whole of biological history provides an affirmative answer. This extinction may be brought about in one of many ways, and in the remote, or in the near, future. Let us enumerate some of these.

1. The sudden release of the energy now stored within the atoms of the sun (or earth) with the production of a radioactive explosion and formation of a *nova* or new star.

2. The gradual cooling of the earth's surface to below the freezing point of water consequent on the diminution of the sun's radiation which is occurring at a rate equivalent, according to Jeans, to the burning of many thousands of millions of tons of coal every second. Even so, humanity might last another million million years.

3. The relatively sudden reduction of the sun from a main sequence star to a white dwarf star resembling the companion of Sirius. This *might* occur in the comparatively near future should our sun, which, says Jeans, is not far from the limit of its "main sequence" stage of evolution, shrink to a white dwarf and emit, as it would, only the four-hundredth part of its present light and heat.

4. Man may be swept away by an epidemic caused by some "lethal" microbe that has mutated in the direction of a capacity to elaborate toxins against which the human organism fails to adapt itself.

5. Passage of the earth through the gaseous part of a comet with the poisoning of all higher forms of life by hydrocarbon gases.

6. Passage of the earth through the nucleus of a comet, and destruction of all higher forms of terrestrial life by an incessant bombardment with meteors. Or the cessation of all life, aquatic and terrestrial, might be brought about by oxygen starvation consequent on the "locking up" of all atmospheric oxygen through union with the incandescent gases and metals. The mathematical probability of the earth passing through the nucleus of a comet is about once in 80 million years. We passed through the tail of the Great Comet in 1861, and grazed Halley's Comet in 1910 without adverse effect.

7. Collision with a meteorite similar to, but much larger than, that which fell on June 30, 1908, near Kansk in Siberia. This latter meteorite, which probably weighed less than 200 tons, set up blasts of air which uprooted trees, started conflagrations, and killed every living thing, including many families of Tunguses, over an area of 60 square kilometres. The shocks it caused were recorded as far away as Kew, and lasted for a quarter of an hour.

8. Minor planets have occasionally passed surprisingly near our earth. Amor, for instance, passed within 10,000,000 miles and 1932 H.A. within 6,000,000 miles. (Our nearest planet, Venus, is 25,700,000 miles distant.) But the record occurred on October 31, 1937, when the planetoid Hermes came perilously close to the earth, actually to within 485,000 miles. Given but a

slight perturbation of this planetoid—which has a diameter of one mile and weighs 3,000,000,000 tons—and it might, on one of its return journeys, come crashing into the earth, with disastrous results.

9. Collision of our sun with another star, the effect of which would be the conversion of both bodies, including all planets and other attendant bodies, into a gaseous nebula. The mean density of matter throughout space is extremely small—according to Hubble $1{\cdot}5 \times 10^{-31}$ times that of water—in other words, the mean distance separating the stars is so vast that the laws of probability give one stellar collision to every million million million years.

II

(p. 12, line 24)

PROBABLY everyone is now familiar with numerous examples of the way in which horticulturists " artificially fertilize " plants. What is not so generally known is that the same methods are being made use of among members of the animal kingdom, not excluding human beings. In the latter this has been effected in cases where, for certain reasons, normal access of the spermatozoa to the ovum is prevented, as, for example, in inflammatory or congenital occlusion of the female lumen. In such case we have a parallelism with the vanilla plant described by Metchnikoff, in which a membrane prevented contact of the male and female sexual organs. An interesting instance of the artificial insemination of a British Friesian cow on Lord Rayleigh's Essex farm by a Friesian bull in Holland took place in 1937. A glass tube containing spermatozoa from the bull was conveyed by aeroplane from Holland, and with these the cow was impregnated 28 hours later,

with the result that in due course she gave birth to a full-sized, healthy calf. (Fig. 18.)

In order to economize the importation, maintenance, and stud-fee, etc., expenses in connection with breeding from valuable stock, artificial insemination is being carried out in Russia with extraordinarily beneficial results. An iron dummy sheep, resembling in essential details of form and appearance the normal creature of flesh and blood, is mounted by a ram. The semen is ejaculated into a receptacle, and with the spermatozoa 5000 ewes were impregnated.

III

(p. 33, line 20.)

The eminent bacteriologist and parasitologist, Dr. George H. F. Nuttall, F.R.S., Emeritus Professor of Biology at Cambridge, whose death occurred while this book was under revision (December 17, 1937), was the first to discover that blood exercises a lethal effect on bacteria, a characteristic on which rested his further discovery of the famous *precipitin* test. Nuttall made more than 19,000 tests on the blood of some 600 species of animals. His discoveries have proved of incalculable service by positively identifying as animal or human minute traces of blood. In this way medico-legal experts and criminologists are enabled to establish innocence or guilt respectively in suspected cases of murder.

Another use to which human blood has been put is the well-known one of "transfusion" to save the life of a person who has lost a large proportion of his own blood. The procedure has its disadvantages—it is, for instance, obviously not entirely devoid of harmful

[*Mid Essex Reporting Agency.*

FIG. 18.—A "TEST-TUBE" CALF BORN ON LORD RAYLEIGH'S ESTATE AT TERLING, ESSEX.

[*To face p.* 198.

effects on the donor. Moreover, the latter must belong to a specific blood group compatible with that in which the latter happens to be, and in urgent cases difficulty may be experienced in finding a suitable donor. Modern Russian scientists have anticipated this difficulty by refusing to allow a misplaced sentiment for the dead to penalize the living—or, put otherwise, they are promoting a principle whereby the life of the living may be saved by the dead. By way of illustration we cannot do better than quote a letter from Dr. M. R. Soni (Withington, Manchester) published in *The British Medical Journal* of December 5, 1936.

"On August 31st a party of British and American doctors visited Professor Yudin's clinic at Sklifasorcogo Hospital for Acute Emergencies in Moscow, and had the interesting experience of seeing a woman surgeon remove all the blood from the body of a patient that had been brought dead to the hospital in an ambulance—death having occurred in the street from *angina pectoris*. This blood, it was explained, would . . . within the next twenty-four days, be used for transfusion purposes. As the hospital received only acute emergency cases . . . from all over Moscow, it naturally received a number of bodies of those who had died suddenly. . . . All such bodies . . . were drained of the blood by a surgeon. The operation was performed with due care and asepsis, within six hours of death, the blood being drained from the internal jugular vein and received in wide-mouthed sterile bottles. A body normally yielded about 2000 to 2500 c.cm. of blood. . . . The blood was kept at a slightly low temperature in a refrigerator. When required the bottle was placed in warm water for a short period before use, it was gently shaken, and its contents injected into the vein by the drip method. Professor Yudin told us that he had given cadaver blood to over 1500 patients without mishap. In a case of carcinoma (cancer) of the stomach occurring in a young woman with twenty per cent. hæmoglobin he gave four litres of blood slowly in two days, and after a week, when the hæmoglobin had risen to seventy per cent., he performed gastrectomy successfully—the patient being still alive two years after the operation. . . . After the blood is drawn the body is in every case subjected to post-mortem examination, and the blood is discarded if death has occurred from tuberculosis, cancer, any acute infectious disease, etc. Further, the blood is carefully examined both bacteriologically and serologically and typed. The blood that

has passed through these tests is considered as good as fresh blood from a donor, if not better. Certainly it is easier to administer. The surgeon told us that cadaver blood 'lived' for twenty-eight days after the death of the person, but to be on the safe side it was discarded after being stored for twenty-four days. We were informed that cadaver blood is being used all over the Soviet Union without any untoward results. The patients are not informed of its nature."

IV

(p. 35, line 31.)

The mathematician Euler, known to his intimates as "analysis incarnate," was a prodigy in calculation. There is a story that "two of his students summed a complicated convergent series in specific numbers and disagreed only by a unit in the fiftieth place of the result. To decide between them Euler did the whole calculation in his head; his answer was found to be correct" (*Nature*).

The following account of the latest prodigy is in *The Medical Record*, December 19, 1934:—

"At the age of six years and seven months, one intellectual prodigy, known as 'K' to the Educational Clinic of City College, has scored the highest intelligence quotient ever recorded at that clinic—that of 196. The significance of this is overpowering when we realize that the quotient of Charles Darwin is approximately 186, and that of Albert Einstein 205. The child's mental level is considered to be that of a boy twice his age. Only one child in a million obtains an intelligence quotient that high. In an association test the youngster is reported to have used such words as 'encyclopædia,' 'evolution,' and 'luminosity.'"

Note.—The "intelligence quotient," or I.Q., is a number representing the general intelligence of an individual. This number is obtained by dividing the "mental age" by the time or "chronological age," and multiplying the result by 100; thus a child 7 years old with a mental age of 9 years has I.Q. = 900/7 or 128.

V

(p. 45, line 6)

Number and Causes of Deaths in England and Wales during 1925–35 classified by Sex

The trend of certain diseases, *e.g.*, Tuberculosis (decrease) and Cancer (increase), is indicated. Data compiled from *Registrar General's Statistical Reviews*: Part I, *Medical*; Part II, *Civil*.

Population is in thousands, *e.g.*, 38,890 signifies 38,890,000. M. = Males; *F.* = *Females*; T. = Total.

The Table should be compared with Metchnikoff's text, pp. 37–45.

Cause of Death.	Sex.	1925.	1926.	1927.	1928.	1929.	1930.	1931.	1932.	1933.	1934.	1935.	1925 to 1935. Total.	1925 to 1935. Mean.
Poisoning by Lead, etc.	M.	34	52	53	61	52	44	38	40	33	36	32	475	43·18
	F.	7	9	3	12	4	5	3	7	7	5	1	63	5·72
Alcoholism.	M.	95	76	84	74	85	49	40	61	43	33	50	690	62·72
	F.	55	39	24	34	49	45	41	34	30	19	23	393	35·72
Syphilis.	M.	726	784	865	993	892	918	956	834	870	838	879	9,555	868·63
	F.	459	470	541	539	497	496	490	469	451	396	363	5,171	470·09
Old Age.	M.	10,202	10,036	9,150	7,976	8,495	7,345	7,120	7,250	6,703	6,331	6,807	87,415	7,946·81
	F.	15,112	14,528	13,603	11,774	12,685	10,772	10,867	11,016	10,435	9,735	10,186	120,713	11,883·00
Violence, including Suicide.	M.	12,903	12,993	14,162	14,810	15,184	15,585	14,547	14,981	15,295	15,178	14,501	160,139	14,558·09
	F.	5,648	5,929	6,227	6,753	6,936	6,832	7,031	6,888	7,385	7,553	7,462	74,644	6,785·81
Digestive Diseases and Appendicitis.	M.	14,912	15,021	14,148	14,417	15,173	14,310	14,093	14,058	14,004	13,813	14,058	158,007	14,364·27
	F.	12,564	12,572	11,813	12,184	12,458	11,677	11,656	11,994	11,946	12,173	11,613	132,650	12,059·09
Tuberculosis.	M.	22,238	20,673	20,919	20,161	21,292	19,790	19,941	18,743	18,734	17,448	16,543	216,482	19,680·18
	F.	18,154	16,857	17,261	16,471	16,709	15,960	15,877	14,915	14,525	13,434	12,658	172,821	15,711·00
Nervous Diseases.	M.	22,601	22,094	20,655	19,456	20,630	19,008	19,569	19,429	18,669	18,622	18,830	219,563	19,960·27
	F.	23,298	23,331	22,059	21,088	21,830	20,837	20,860	21,029	20,399	20,685	21,010	236,426	21,493·27
Cancer.	M.	24,900	25,468	26,062	27,084	27,330	28,030	28,908	29,960	29,925	30,943	31,894	310,504	28,227·63
	F.	29,456	30,402	30,648	31,851	32,212	32,674	33,281	33,604	34,446	35,204	35,398	359,176	32,652·36
Respiratory Diseases.	M.	41,548	36,659	40,699	32,947	44,732	29,362	34,384	29,318	30,269	27,972	26,594	374,484	34,044·00
	F.	36,281	31,169	35,242	26,544	38,619	22,555	29,623	25,490	25,971	22,139	20,669	314,302	28,572·90
Heart and Circulatory Diseases.	M.	41,789	42,500	48,326	52,070	58,337	55,044	60,735	62,241	64,569	66,033	68,988	620,632	56,421·09
	F.	43,448	43,881	50,565	54,274	62,729	57,433	64,749	65,525	68,755	68,566	71,798	651,723	59,247·54
All other Diseases.	M.	48,927	45,193	51,483	45,493	57,701	44,525	49,386	48,800	51,511	45,608	44,282	532,909	48,446·27
	F.	47,484	43,068	50,017	43,323	57,861	52,131	47,435	47,443	51,490	44,046	42,762	527,060	47,914·54
All Causes.	M.	240,875	231,549	246,606	235,542	269,903	234,010	249,717	245,715	250,625	242,855	243,458	2,690,855	244,623·18
	F.	231,966	222,255	238,003	224,847	262,589	221,417	241,913	238,414	245,840	233,955	233,943	2,595,142	235,922·00
	T.	472,841	453,804	484,609	460,389	532,492	455,427	491,630	484,129	496,465	476,810	477,401	5,285,997	480,545·18
Population (in thousands).	M.	18,602	18,698	18,804	18,896	18,969	19,075	19,160	19,280	19,357	19,412	19,500	209,753	19,068·45
	F.	20,288	20,369	20,486	20,586	20,638	20,731	20,828	20,921	20,993	21,055	21,145	228,040	20,730·90
	T.	38,890	39,067	39,290	39,482	39,607	39,806	39,988	40,201	40,350	40,467	40,645	437,793	39,799·36
Death-rate, all causes (per 1,000 living population).	M.	12·9	12·4	13·1	12·5	14·2	12·3	13·0	12·7	12·9	12·5	12·5	—	12·82
	F.	11·4	10·9	11·6	10·9	12·7	10·7	11·6	11·4	11·7	11·1	11·1	—	11·38
	Av.	12·2	11·6	12·3	11·7	13·4	11·4	12·3	12·0	12·3	11·8	11·7	—	12·07

VI
(p. 61, line 17)

Table showing Ages at First and Subsequent Marriages of Persons in England and Wales during the Year 1935

Compiled from data in the *Registrar General's Statistical Review* for 1935, Part II, *Civil*. (Refer to Table on p. 61.)

Age.	Males.			Females.		
	First Marriage.	Subsequent Marriage.	Total.	First Marriage.	Subsequent Marriage.	Total.
16–20	13,049	3	13,052	52,161	19	52,180
21–24	102,251	138	102,389	134,017	257	134,274
25–29	135,778	1,143	136,921	97,839	1,063	98,902
30–34	47,320	2,317	49,637	29,007	1,911	30,918
35–39	13,984	2,692	16,676	10,028	2,391	12,419
40–44	5,556	2,749	8,305	4,529	2,385	6,914
45–49	2,976	3,078	6,054	2,478	2,107	4,585
50–54	1,506	3,106	4,612	1,313	1,667	2,980
55–59	824	2,955	3,779	654	1,203	1,857
60–64	444	2,393	2,837	397	855	1,252
65–69	256	1,730	1,986	187	645	832
70–74	98	906	1,004	56	269	325
75–79	21	359	380	4	71	75
80–89	8	85	93	2	12	14
90–upwards	0	0	0	0	1	1
	324,071	23,654	347,725	332,672	14,856	347,528
Over 21 but no age given	1,198	613	1,811	1,685	323	2,008
Total	325,269	24,267	349,536	334,357	15,179	349,536

VII

(p. 65, line 27)

Table showing Number of Illegitimate Births and their Proportion to Total Number of Births in Ten different parts of the World.

Country.	Year.	Total Number of Births.	Number of Illegitimate Births.	Percentage of Illegitimate Births.
Netherlands . .	1932	178,525	3,091	1·73
Belgium . . .	1932	144,835	5,133	3·54
England and Wales .	1933	580,413	25,408	4·37
Northern Ireland .	1932	25,107	1,268	5·05
Italy . . .	1932	992,049	51,184	5·15
Norway . . .	1932	46,338	3,005	6·34
Scotland . . .	1933	86,546	5,964	6·89
France . . .	1932	722,246	56,827	7·86
Finland . . .	1932	69,352	5,863	8·45
Denmark . .	1932	64,560	6,907	10·69
Germany . .	1931	1,063,921	126,383	11·87
Sweden . . .	1932	89,733	13,857	15·44
Chile . . .	1932	149,459	54,702	36·60

VIII

(p. 85, line 2)

Metchnikoff's statement that more old than young men commit suicide presumably referred to conditions on the Continent. In this country the highest incidence of suicides, both absolutely and relatively to population at the ages in question, is from 55 to 65 years of age. The data are calculated from figures presented by the *Registrar General's Statistical Review* for 1935.

Table showing Absolute and Relative Number of Suicides in England and Wales during 11 Years, 1925 to 1935 inclusive.

The population is to the nearest thousand; thus, 18,602 represents 18,602,000.

Year.		1925.	1926.	1927.	1928.	1929.	1930.	1931.	1932.	1933.	1934.	1935.	Mean 1925–35.
Population.	Males . .	18,602	18,698	18,804	18,896	18,969	19,075	19,160	19,280	19,357	19,412	19,500	19,068
	Females . .	20,288	20,369	20,486	20,586	20,638	20,731	20,828	20,921	20,993	21,055	21,145	20,730
	Total . .	38,890	39,067	39,290	39,482	39,607	39,806	39,988	40,201	40,350	40,467	40,645	39,799
Suicides. (Abs.)	Males . .	2,852	3,099	3,458	3,409	3,480	3,527	3,624	4,054	3,893	3,839	3,525	3,523
	Females . .	1,232	1,350	1,449	1,473	1,504	1,524	1,523	1,689	1,761	1,711	1,698	1,537
	Total . .	4,084	4,449	4,907	4,882	4,984	5,051	5,147	5,743	5,654	5,550	5,223	5,061
(Rel.)	Males . .	153	165	183	180	183	184	189	210	201	197	180	184
	Females . .	60	66	70	71	72	73	73	80	83	81	80	74
	Total . .	165	113	124	123	125	121	128	142	140	137	128	127

Table showing Absolute and Relative Number of Suicides in England and Wales during the Year 1935 Classified According to Age.

The absolute population is shown. The relative number of suicides are per hundred thousand of population at the age in question.

Age.		0–10.	10–15.	15–20.	20–25.	25–35.	34–45.	45–55.	55–65.	65–75.	75 and upwards.	Total.
Population.	Male . .	2,954,800	1,730,800	1,557,800	1,677,000	3,314,100	2,632,300	2,314,300	1,891,600	1,064,190	363,110	19,500,000
	Female .	2,883,500	1,697,600	1,532,400	1,737,200	3,471,000	3,072,500	2,715,500	2,159,600	1,304,600	571,100	21,145,000
	Total . .	5,838,300	3,428,400	3,090,200	3,414,200	6,785,100	5,704,800	5,029,800	4,051,200	2,368,790	934,210	40,645,000
Suicides. (Abs.)	Male . .	0	4	58	164	461	473	768	911	509	177	3,525
	Female .	0	1	21	81	266	355	423	332	171	48	1,698
	Total . .	0	5	79	245	727	828	1,191	1,243	680	225	5,223
(Rel.) per 100,000 of pop.	Male . .	0	0·230	3·723	9·779	13·910	17·969	33·184	48·160	47·829	48·745	18·076
	Female .	0	0·059	1·370	4·662	7·663	11·555	15·577	15·373	13·107	8·404	8·029
	Total	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

IX

(p. 127, line 34)

In no way could the extent to which medical science is conserving human life be better shown than by the improvement in successive years of the rates of Infant Mortality. The figures are from the *Registrar General's Statistical Review of England and Wales.*

Deaths of Infants under One Year per 1,000 Live Births.

Year.	Total.	Legitimate.	Illegitimate.
1906	132	127	261
1907	118	113	220
1908	120	116	233
1909	109	104	211
1910	105	102	195
1911	130	125	245
1912	95	91	181
1913	108	104	213
1914	105	100	207
1915	110	105	203
1916	91	87	183
1917	96	90	201
1918	97	91	186
1919	89	84	173
1920	80	76	156
1921	83	79	158
1922	77	74	139
1923	69	67	132
1924	75	73	133
1925	75	72	136
1926	70	68	130
1927	70	67	120
1928	65	63	115
1929	74	72	126
1930	60	58	105
1931	66	64	111
1932	65	63	112
1933	64	62	107
1934	59	57	95
1935	57	56	90

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